

## Overview



### What's New

The MacBook Pro (Retina, 13-inch, Early 2015) features:

- **Processor:** 2.7GHz, 2.9GHz, or 3.1GHz Intel dual-core processor
- **Retina display:** 13.3-inch (diagonal) Retina display with higher efficiency LEDs
- **Memory:** 8GB or 16GB on board, not user installable
- **Storage:** 128GB, 256GB, 512GB, or 1TB flash storage
- **Graphics:** Broadwell GT3 Integrated Graphics (IG)
- **Trackpad:** Force Touch Trackpad technology

Diagnostics:

- Apple Service Toolkit version 2 (AST 2)
- Trackpad: The [Trackpad Calibration Check](#) must be performed after every repair.

The MacBook Pro (Retina, 13-inch, Late 2012, Early 2013, Late 2013, Mid 2014) features:

- **Processor:**
  - For Late 2012 model: 2.5GHz or 2.9GHz Intel dual-core processor
  - For Early 2013 model: 2.6GHz or 3.0GHz Intel dual-core processor
  - For Late 2013 model: 2.4GHz or 2.6GHz Intel dual-core processor
  - For Mid 2014 model: 2.6GHz, 2.8GHz, or 3.0GHz Intel dual-core processor
- **Retina display:** 13.3-inch (diagonal) Retina display (2560-by-1600 resolution, 227 ppi)

- **Memory:**
  - For Late 2012 and Early 2013 models: 8GB on board, not user installable
  - For Late 2013 model: 4GB, 8GB, or 16GB on board, not user installable
  - For Mid 2014 model: 8GB or 16GB on board, not user installable
- **Storage:**
  - For Late 2012 and Early 2013 models: 128GB, 256GB, 512GB, or 768GB flash storage
  - For Late 2013 and Mid 2014 models: 128GB, 256GB, 512GB or 1TB flash storage
- **Expansion ports:**
  - For Late 2012 and Early 2013 models: Two Thunderbolt ports up to 10 Gbps, two USB 3 ports (up to 5 Gbps), one SD card slot, and one HDMI port (used to connect an HDTV or projector, extend a desktop, or mirror to an external display)
  - For Late 2013 and Mid 2014 models: Two Thunderbolt 2 ports up to 20 Gbps, two USB 3 ports (up to 5 Gbps), one SD card slot, and one HDMI port (used to connect an HDTV or projector, extend a desktop, or mirror to an external display)
- **MagSafe 2 power adapter:** 60W with MagSafe 2 straight-plug orientation
- **Product name on bottom case:** The name “MacBook Pro” appears on the bottom case instead of on the base of the display

For product configurations, refer to AppleCare Tech Specs at [support.apple.com/specs/#macbookpro](https://support.apple.com/specs/#macbookpro).

## Important Service Considerations

This computer model’s design requires special service considerations:

- **Training:** This computer should only be repaired by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- **Battery Service:** The battery is not a replaceable part. Never remove the battery from the top case. To replace a battery, you must replace the top case.
- **Battery Safety:** Before beginning any repair procedure, install the battery cover. For Late 2012 and Early 2013 models, remove the BMU interlock screw. For Late 2013, Mid 2014, and Early 2015 models, disconnect battery connector. Refer to article [TP890: Battery Safety Precautions](#).
- **Top Case:**
  - For Early 2015 models: The top case includes the battery, BMU, keyboard, microphone, trackpad flex cable, and trackpad. (Small removable parts such as screws, gaskets, flexures, and clutch screw covers are included in replacement parts.) If the battery, keyboard, microphone, or trackpad must be replaced, you must replace the top case. Refer to article [TP1058: Battery Handling and Storage](#).
  - For Late 2013 and Mid 2014 models: The top case includes the battery, BMU, keyboard, microphone, and trackpad. (Small removable parts such as screws, flexures, and clutch screw covers are included in replacement parts.) If the battery, keyboard, microphone, or trackpad must be replaced, you must replace the top case. Refer to article [TP1058: Battery Handling and Storage](#).
  - For Late 2012 and Early 2013 models: The top case comes with the battery, BMU, keyboard, microphone, and small removable parts such as Mylar BMU cover, screws, flexures, and clutch screw covers. If the battery, keyboard, or microphone must be replaced, you must replace the top case. Refer to article [TP923: Battery Handling and Storage](#).
- **2D Bar Codes:** This computer includes 2D bar codes that require service providers to have updated bar code scanners. It is important to upgrade scanners to read 2D bar codes in order to enter part serial numbers in GSX. To upgrade the Motorola DS6707 scanner, refer to article [OP53: Bar Code Scanner Information and Configurations](#).
- **Wireless Card:** The wireless card comes with a thermal pad attached to the underside. When lifting the card from the logic board, check that the pad remains with the card. The thermal pad is available as a separate service part (923-0150).
- **Interposer (Late 2012 and Early 2013 models only):** The interposer is available as a separate service part (661-7045). Use only ESD-safe nonconductive interposer tweezers (included in kit 076-1411) to remove, transfer, or install the interposer. The only parts that require removal of the interposer are logic board assembly (with MagSafe, heat sink, fan ducts, and fans attached), logic board, MagSafe, audio board, trackpad, and top case.
- **Right and Left Speakers:** The right and left speakers are paired and only offered as a kit. If you need to replace one speaker, you must replace both. Do not save a used, good speaker for another repair. The speakers are fine-tuned to each other by the manufacturer and will not operate properly if mismatched.
- **Fan Ducts on Heat Sink:** The fan ducts are rubber gaskets that wrap around the heat sink. The heat sink must be removed to access the fans and replace the fan ducts.
- **Display Assembly:** The display assembly comes with a set of left and right clutch screw covers.
- **Trackpad with Cable (Late 2012 and Early 2013 models only):** The trackpad comes with the trackpad cable attached. If the trackpad cable needs to be replaced, you must replace the trackpad.

## Starter Kits

For Late 2013, Mid 2014, and Early 2015:

- Battery Safety Kit - refer to article [OP685: About embedded battery safety](#)
- 923-0705 Battery Cover, package of two
- 923-0731 Pentalobe Driver

For Late 2012 and Early 2013:

- Battery Safety Kit - refer to article [OP685: About embedded battery safety](#)
- 076-1411 Battery Covers Kit (also includes the ESD-safe nonconductive interposer tweezers)
- 923-0731 Pentalobe Driver

### **Use Software Update**

The MacBook Pro (Retina, 13-inch, Early 2015) ships with a model-specific version of OS X. Check Apple Support article [HT204319: Mac OS X versions \(builds\) for computers](#) to make sure the system build is correct for this computer model. Using Software Update, check for and apply the latest software and firmware updates.

# Battery Safety Setup

## Battery Safety Setup for MacBook and MacBook Pro (Mid 2012 and later)



**Warning:** Before servicing a MacBook or MacBook Pro computer, read and understand article [OP24: Safely handling lithium batteries and lithium battery-powered devices](#).

For information on how to set up your workstation, refer to article [OP685: About embedded battery safety](#).



# Battery Handling and Storage

## Best Practices

The battery contains several soft battery cells. Do not press on the battery cells with your fingers, and do not handle the battery pack in any way that might apply any physical pressure to these cells.

- [Always attach the battery cover and disconnect the battery](#) immediately after removing the bottom case and before beginning any repair. Check that both clips on the battery cover attach to the midwall of the top case.
- Do not use a damaged battery cover. If the battery cover is damaged, replace it.
- Only remove the battery cover and connect the battery right before replacing the computer's bottom case. Keep the battery cover on and the battery disconnected at all other times.
- In the event a top case assembly with battery is dropped, DO NOT use the part. If the top case has been dropped, replace it.

## Battery Inspection

Refer to article [OP693: Visual battery inspection](#) for the latest visual inspection details.

## Packaging a Top Case Assembly with Battery for Return

### Important: Do not discard top case packaging!

The same cardboard box and inner packaging used to ship a known-good top case assembly with battery must be used when returning the known bad board from the repair (KBB).



**PACKING LIST/INVOICE ENCLOSED**

Package contains Lithium Ion cells and batteries. Handle with care. Do not damage. Batteries can be damaged if damaged. If package is damaged, inspect for damage, repair package & return to shipper via ground transport. Damaged lithium batteries are forbidden for air transport per IATA A15A. For emergency info, contact CHEMREC at 1-800-424-9390 from the USA. Outside USA, dial collect 1-703-527-3867.

**CAUTION**



**DO NOT LOAD OR TRANSPORT PACKAGE IF DAMAGED**

For emergency information, call CHEMREC at 1-800-424-9390 from the USA. Outside the USA, dial collect 1-703-527-3867.

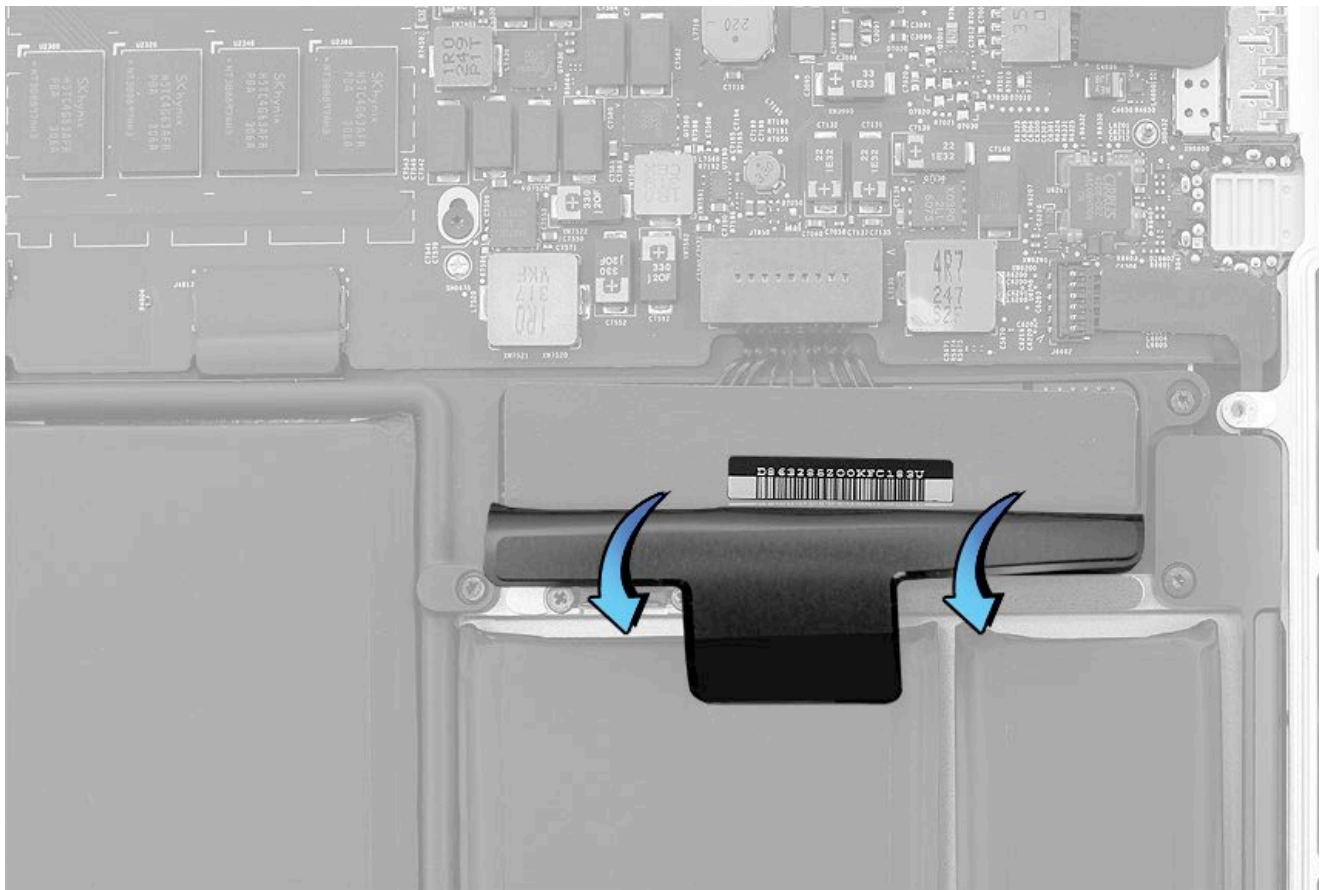
**ATTENTION**

SHARP POINTS  
FRAGILE  
ELECTRONIC  
EQUIPMENT



1. Verify packaging is in good condition and labels are present, legible, and intact. Verify box is well structured and strong.
2. If the box is in good condition but needs a packing list, print a new packing list from Apple Support article [HT204643: Prepare lithium batteries and devices powered by lithium batteries for shipping](#).
3. If the box is in poor condition, order a replacement box kit. The kit includes the outer cardboard box, foam frame, two foam pads, labels, and an ESD-safe or plastic bag.
4. Reuse the protective battery cover from the original top case removal or order a new battery cover if needed.
5. Ensure that the protective battery cover is securely attached to the battery and the battery is disconnected. Install battery cover and disconnect battery as soon as the bottom case is removed. Keep battery cover in place and the battery disconnected for all subsequent part removals.
6. Find the battery serial number underneath the flap near the battery connector. Scan or copy the original battery serial number when reporting the return of the top case assembly with battery to Apple.



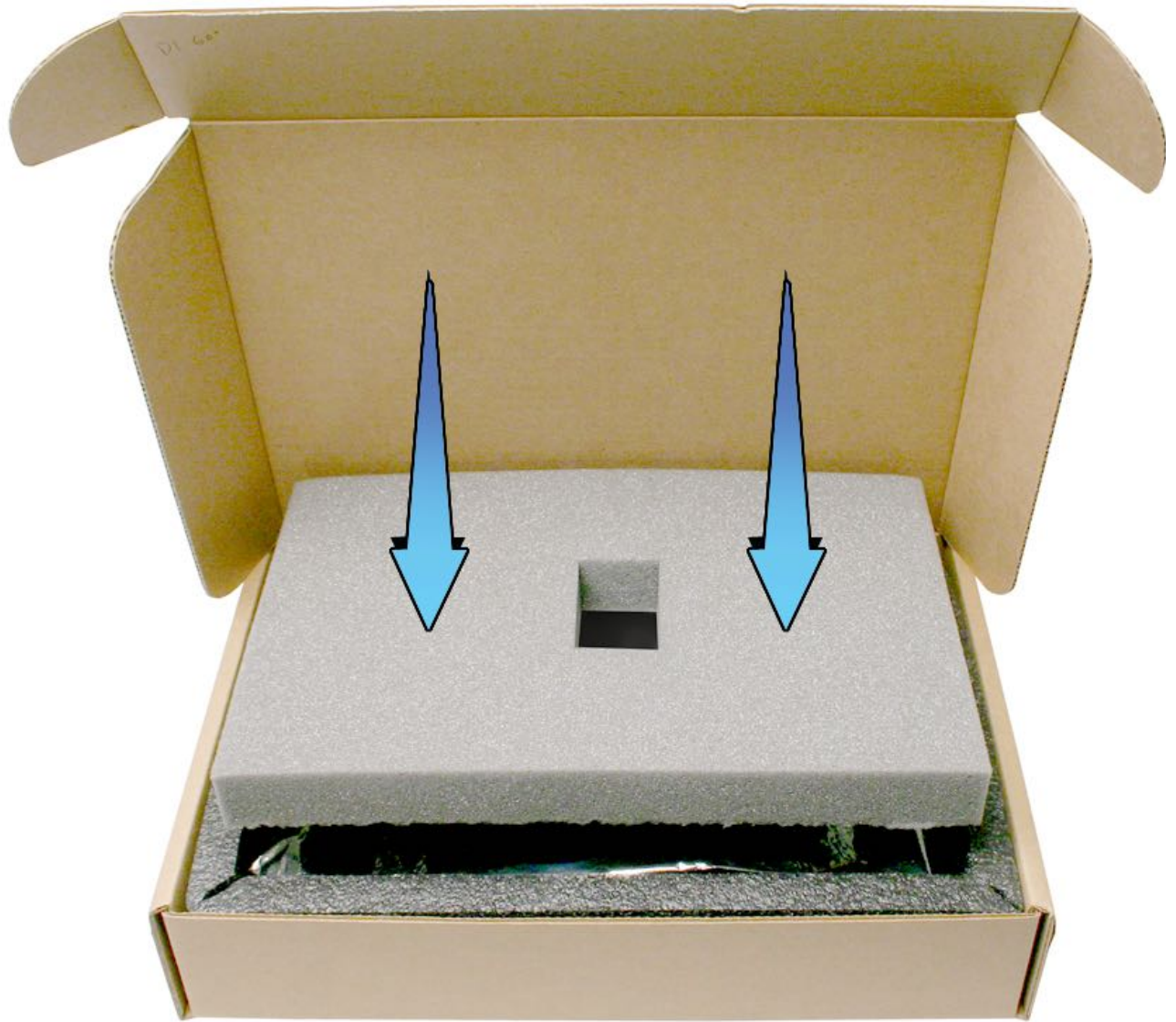


6.

7. Place top case with covered battery inside bag.
8. Fold over bag and seal it closed with yellow ESD sticker. (If sticker is not available, use tape.)
9. Place wrapped top case on bottom foam pad within inner foam frame inside cardboard box.
10. **IMPORTANT:** When placing wrapped top case into the box, make sure battery is face up and at the front opening of the box.



11. Carefully place second foam pad over wrapped top case.



11.

12. Close box and seal it with tape - **DO NOT USE** staples.
13. Check that the Caution label and packing list are attached to the box.
14. Attach a shipping label and return top case assembly with battery using normal shipping procedures.





# Keycap Replacement

## Topic

Service packages of replacement keycaps are available for MacBook Pro (Retina, 13-inch, Late 2012 to Early 2015) and MacBook Pro (Retina, 15-inch, Mid 2012 to Mid 2015). The packages allow you to replace individual keycaps rather than the entire top case.

The following instructions explain how to remove and replace a keycap and scissor mechanism (plastic piece under keycap that secures keycap to top case) on these computers:

- MacBook Pro (Retina, 15-inch, Mid 2012)
- MacBook Pro (Retina, 13-inch, Late 2012)
- MacBook Pro (Retina, 13-inch, Early 2013)
- MacBook Pro (Retina, 15-inch, Early 2013)
- MacBook Pro (Retina, 13-inch, Late 2013)
- MacBook Pro (Retina, 15-inch, Late 2013)
- MacBook Pro (Retina, 13-inch, Mid 2014)
- MacBook Pro (Retina, 15-inch, Mid 2014)
- MacBook Pro (Retina, 13-inch, Early 2015)
- MacBook Pro (Retina, 15-inch, Mid 2015)

If a keycap needs replacement due to accidental damage, such as a liquid spill, refer to [OP14: Determining and quoting accidental damage to Mac portables](#).

To help determine keyboard localization or keycap placement, see [HT201794: How to identify keyboard localizations](#).

### Notes:

- Keycap kits are available for International English, U.S. English, and Japanese version keyboards.
- A European Special Character kit is available with British (B), German (D), French (F), Danish (DK), Italian (T), Spanish (E), and Swedish (S) specific keycap characters.
  - **Note:** To receive the proper keycaps to complete a single British, German, French, Danish, Italian, Spanish or Swedish keyboard, order both the European Special Character Kit **and** the ISO English keycap kit. Neither kit by itself contains all the keycaps necessary for a single localized keyboard.
- Always shut down the computer before replacing a keycap.

### Identifying Keycaps and Scissors

Eight types of keycap packages are offered based on region and keyboard type (Version D and Version S).

Part Number	Keyboard Type	Language
923-0065	Version D	ANSI English
923-0130	Version S	ANSI English
B923-0065	Version D	ISO English
B923-0130	Version S	ISO English
J923-0065	Version D	Japanese
J923-0130	Version S	Japanese
ZM923-0065	Version D	European Special Character Kit
ZM923-0130	Version S	European Special Character Kit

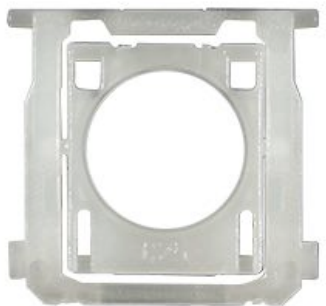
Although the scissors for both versions D and S keyboards function the same, they have a slightly different design. Be sure to match only Version D keycaps to Version D scissors/keyboards and Version S keycaps to Version S scissors/keyboards.

The photos below identify version D and version S scissors.

### Version D scissors



### Version S scissors



## Keycap Map

The following illustrations summarize the differences in removing keycaps on the MacBook Pro (Retina, Mid 2012) keyboard. For detailed instructions, see the [Procedure](#) section below.

- **Yellow:** No stabilizer bar under key cap
- **Orange:** Hooked stabilizer bar under key cap (two hooked bars under Space Bar)
- **Stripes:**
  - **No Stripes:** Lift key from the lower corners
  - **Stripes:** Lift key from the upper corners

### ANSI English Key Layout

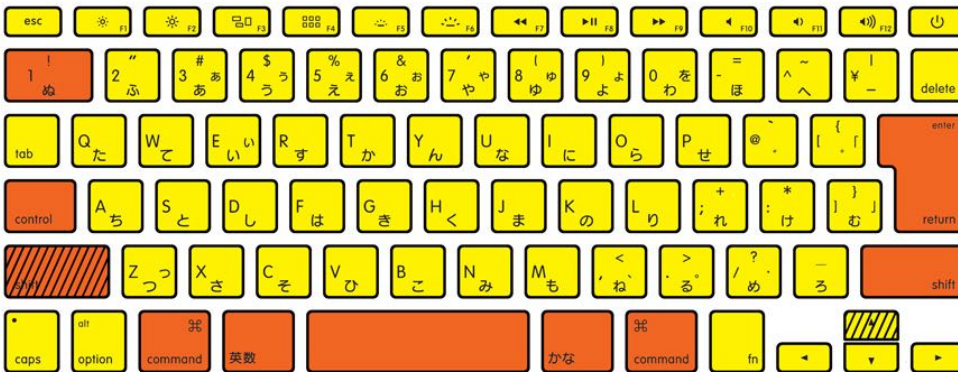


### ISO English Key Layout





## ISO Japanese Key Layout



## Procedure

Use the following steps to remove a defective keycap and replace it with a new keycap and scissors from the service keycap package. When replacing a keycap, replace the scissors below it.

Because the design of the keycap and scissor mechanism differs depending on the shape of the key, the procedure is divided into three parts:

1. [Square keys and small rectangular keys](#) (for example, letters A–Z, numbers, punctuation, function keys, and arrow keys). These use one scissor mechanism beneath the key.
2. [Rectangular keys](#) (for example, Shift, Delete, and Return). These use one or two scissor mechanisms and one stabilizer bar (no stabilizer bar on bottom row for rectangular keys)
3. [Space bar](#). This uses two scissor mechanisms and two metal stabilizer bars.

**Note on illustrations:** Most of the steps are illustrated with version D scissors. However, the steps are the same for version S scissors except where indicated.

**Important:** Shut down the computer before replacing a keycap.

## Removing and Replacing Square Keys and Small Rectangular Keys

1. Pry the key up from the lower edge—first at one corner and then at the other. Exception: Pry the Up Arrow keycap from the upper edge.

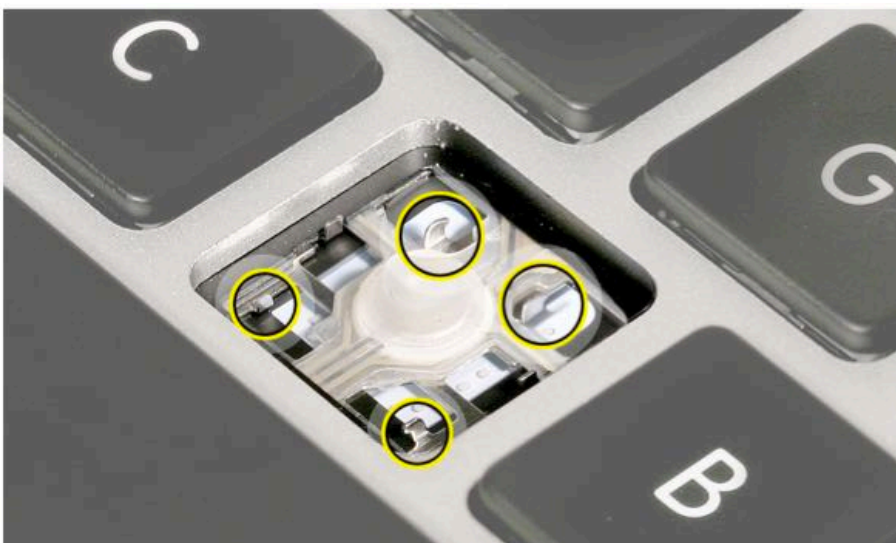


2. Pry and remove the scissor mechanism from the keycap well.



3. Check the rubber dome and raised metal areas inside the keycap well.

- When the rubber dome is pressed and released, it should spring back upright. If the rubber dome is off center or damaged, replace the top case.
- If the metal hook that holds the slider bar of the scissor mechanism is bent, try to bend it back to a uniform 90-degree angle. If it is bent or broken beyond repair, replace the top case.
- If the two metal ears are bent, use needlenose pliers to straighten them. If either or both ears are broken beyond repair, replace the top case.



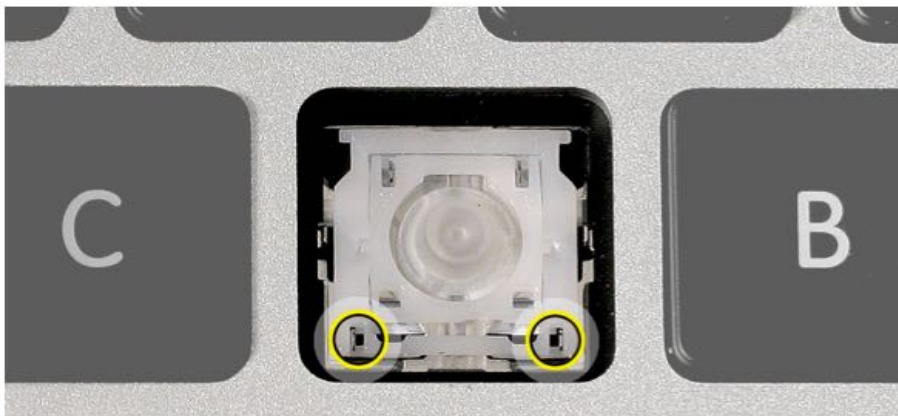
**Note:** To install the replacement scissor mechanism, you must first remove it from the replacement keycap.

4. Position the pointed end of a black stick under both plastic layers on the pin side of the scissors. Pry up and remove the scissors from the keycap.

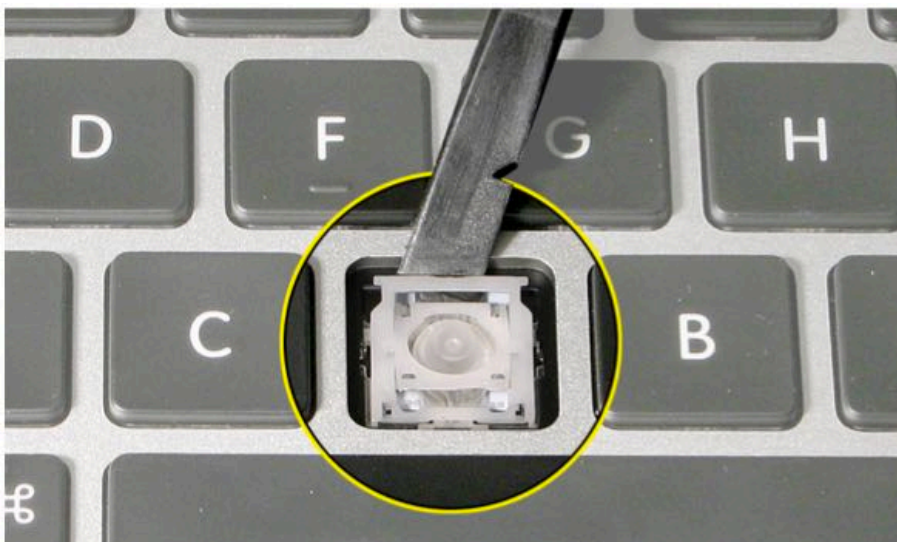


5. To install the replacement scissors in the keycap well, position the scissors so that the smooth side faces up. Holding the scissors closed, fit the two small square openings in the scissors onto the two metal hooks at the lower edge of the keycap well.

6. Press and slide the scissors up until the two rectangular openings in the scissors fit over the two metal hooks at the upper edge of the keycap well.



7. Use a black stick to raise and lower the scissor mechanism to make sure it moves freely.



8. Slide the upper edge of the keycap into the keycap well. Then, press down on the top of the key until you feel it snap into place.





9. Check the key from all angles to make sure it is uniformly flat. Press and release the key repeatedly to verify that it springs back each time.

### Removing and Replacing Rectangular Keys (except Space bar)

**Note:** All rectangular keys with a stabilizer bar use one hooked bar.

1. Pry the Space bar from the lower two corners, and lift it up.
2. Detach the stabilizer bar from the left and right openings in the two metal ears in the keycap well.



3. Remove the original scissors and install the replacement scissors. Refer to steps 2–6 under [Removing and Replacing Square Keys and Small Rectangular Keys](#).
4. With the stabilizer bar installed in the replacement keycap, rotate the stabilizer bar approximately 90 degrees out from the key. Then, insert the ends of the bar into the openings in the metal ears in the keycap well.
5. Lower the key over the keycap well and press down on the top of the key until it snaps into place.
6. Check the key from all angles to make sure it is uniformly flat. Press and release the key repeatedly to verify that it springs back each time.

### Removing and Replacing the Space Bar

1. Pry the Space bar from the lower two corners and lift it a short distance.



2. Using a black stick, separate the lower stabilizer bar from the keycap.



3. With the lower edge loosened, pry the Space bar from the upper edge. Use a black stick, if necessary, to tilt up and remove the keycap.

**Note:** To fully remove the keycap, you may need to pry it from the top stabilizer bar. Be sure to remove both stabilizer bars from the keycap well.

4. Remove the original scissors and install the replacement scissors. Refer to steps 2–7 under [Removing and Replacing Square Keys/Small Rectangular Keys](#).

### Version D Space Bar Replacement

1. Orient the replacement Space bar so that the slider hooks on the underside of the key are at the lower edge of the key.

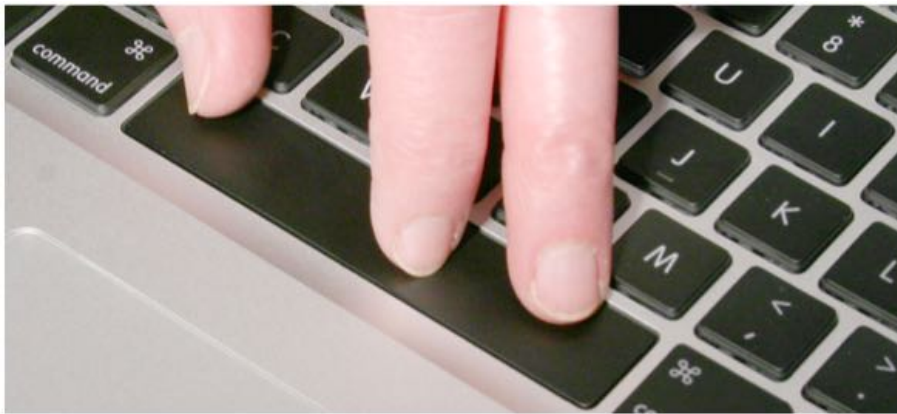


2. Rotate the lower stabilizer bar on the Space bar approximately 90 degrees out from the key and insert the ends of the bar into the two lower metal ears in the keycap well.



3. Insert the ends of the upper stabilizer bar into the two upper metal ears in the keycap well and lower the keycap over the well.

4. Press and slide your fingers along the Space bar until you hear the clips on the top and bottom edges snap into place.



5. Check the key from all angles to make sure it is uniformly flat. Press and release one corner of the key. If the key is installed correctly the opposite corner should respond at the same level (not tilted higher or lower).

### Version S Space Bar Replacement

1. Orient the replacement Space bar so that the slider hooks on the underside of the key are at the lower edge of the key.



2. Using a black stick, remove the top stabilizer bar.





3. Hook the top stabilizer bar into the upper two metal ears in the keycap well.



4. Rotate the lower stabilizer bar on the Space bar approximately 90 degrees out from the key and hook the ends of the bar into the two lower metal ears in the keycap well.



5. Lower the upper edge of the keycap down into the keycap well.

6. Press and slide your fingers along the Space bar until you hear the clips on the top and bottom edges snap into place.

# Serial Number Locations

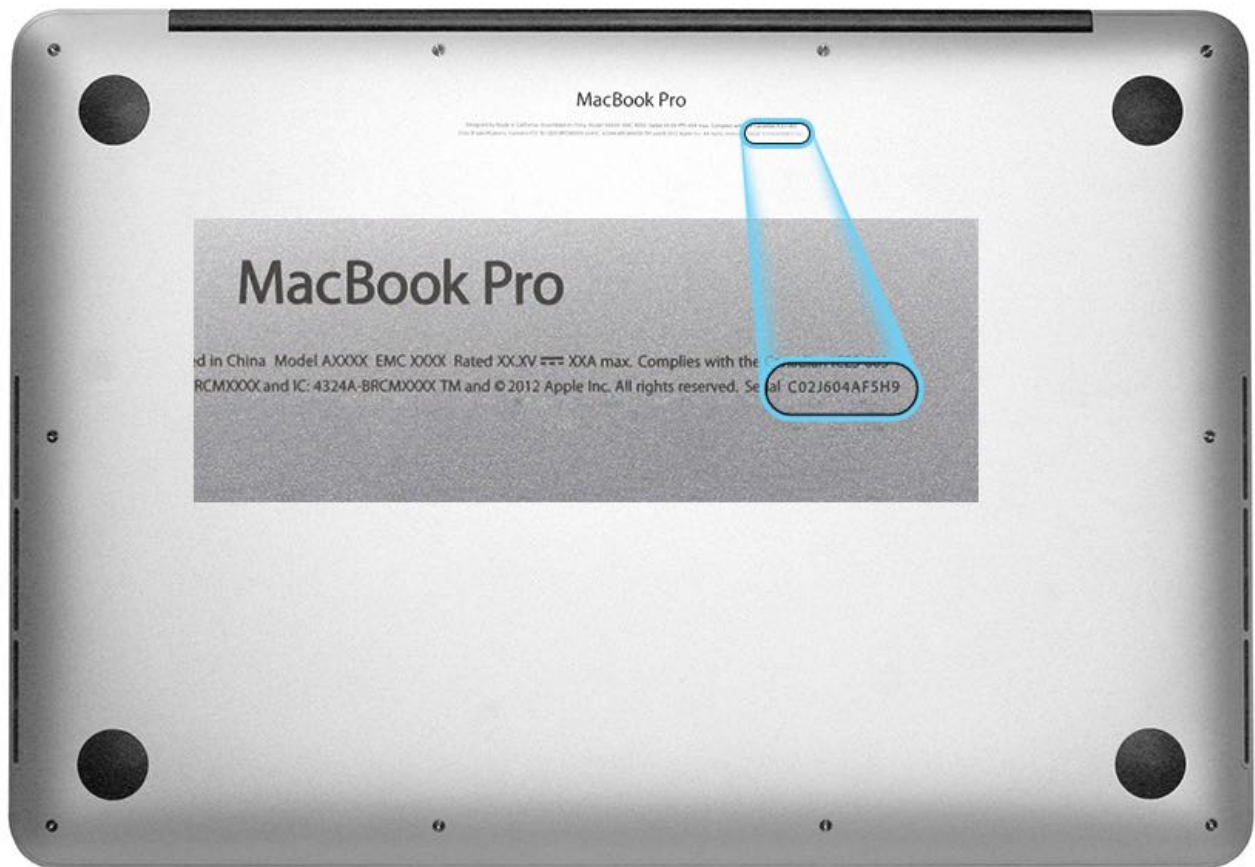
## Serial Number Locations

**Note:** Bar code readers can be used to read serial numbers inside the computer. For information on the serial number format, refer to article [OP51: Frequently Asked Questions and Answers Concerning Apple's New Serial Number Format](#).

## System Serial Number

The system serial number is located in two places on the computer: on the bottom case and on the top case frame.

**Bottom case:** Turn over the computer to see the system serial number etched on the bottom case near the hinge.



## Top case frame:

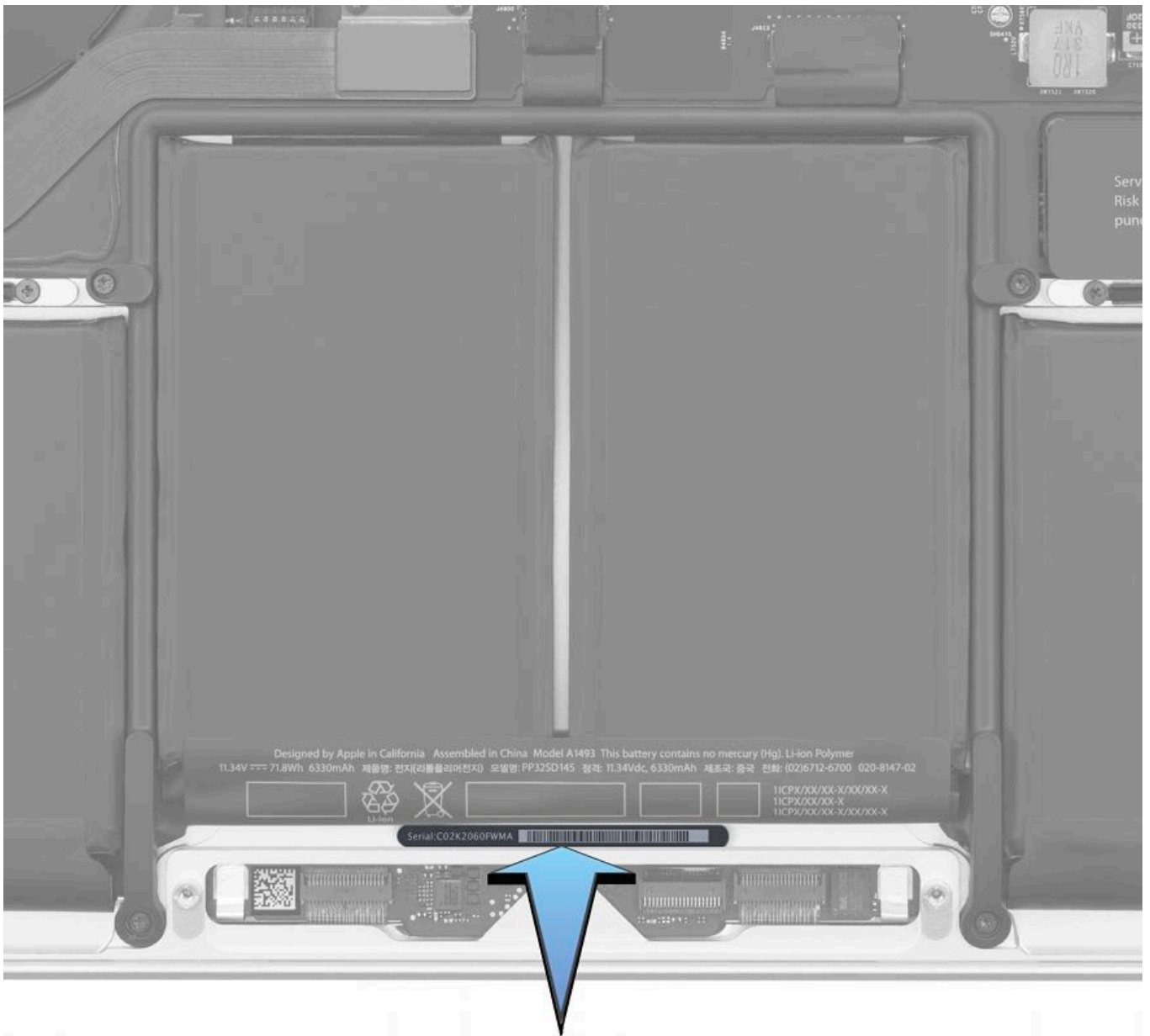
**IMPORTANT:** Before removing the bottom case:

- Always wear ESD wrist strap and take precautions to avoid ESD.
- Always [attach battery cover and disconnect the battery](#) immediately after removing bottom case.

## MacBook Pro (Retina, 13-inch, Late 2013 and Mid 2014) Serial Number Location

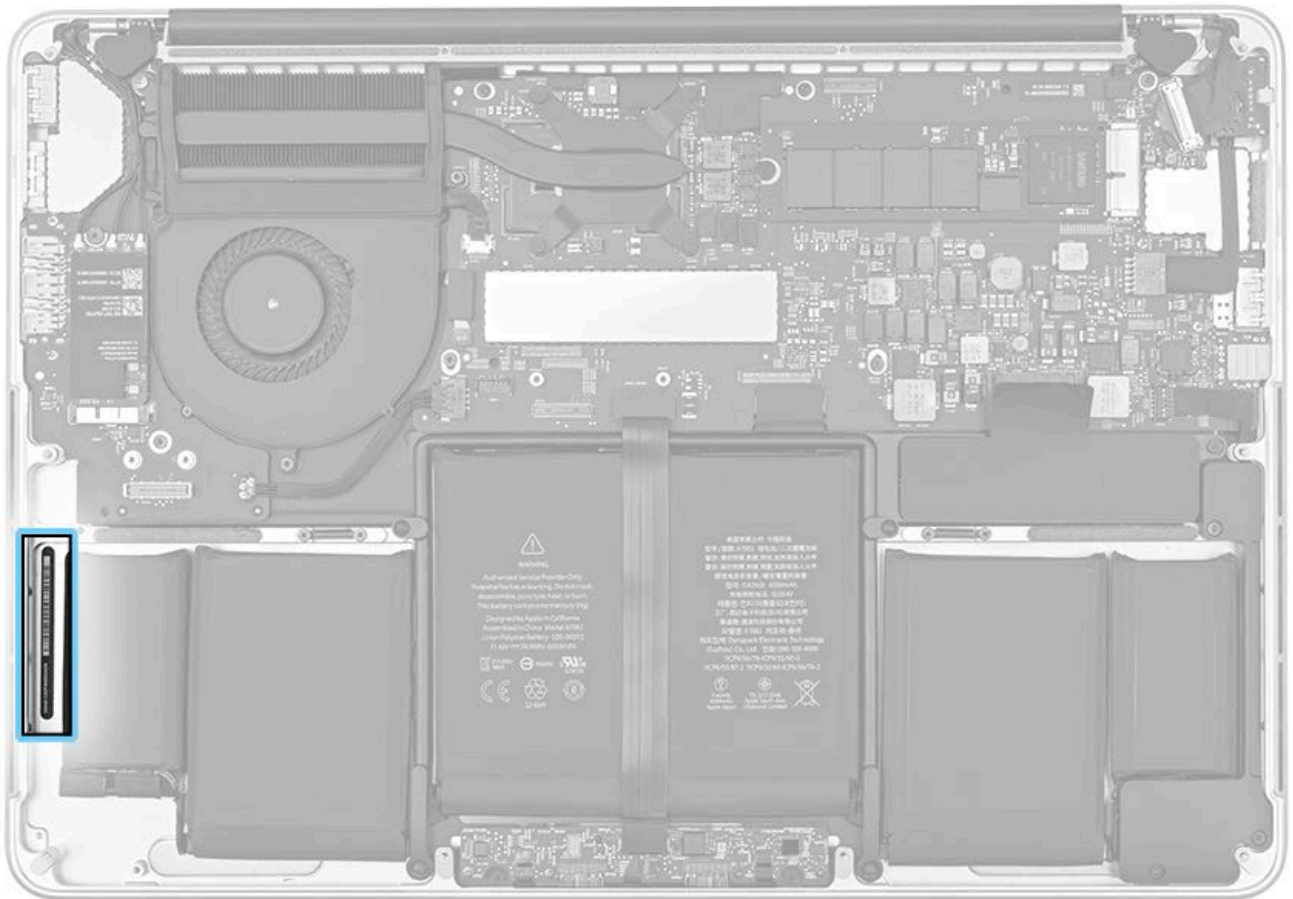
With the bottom case removed, find the system serial number label affixed to the bottom center of the top case frame just below the battery description label.





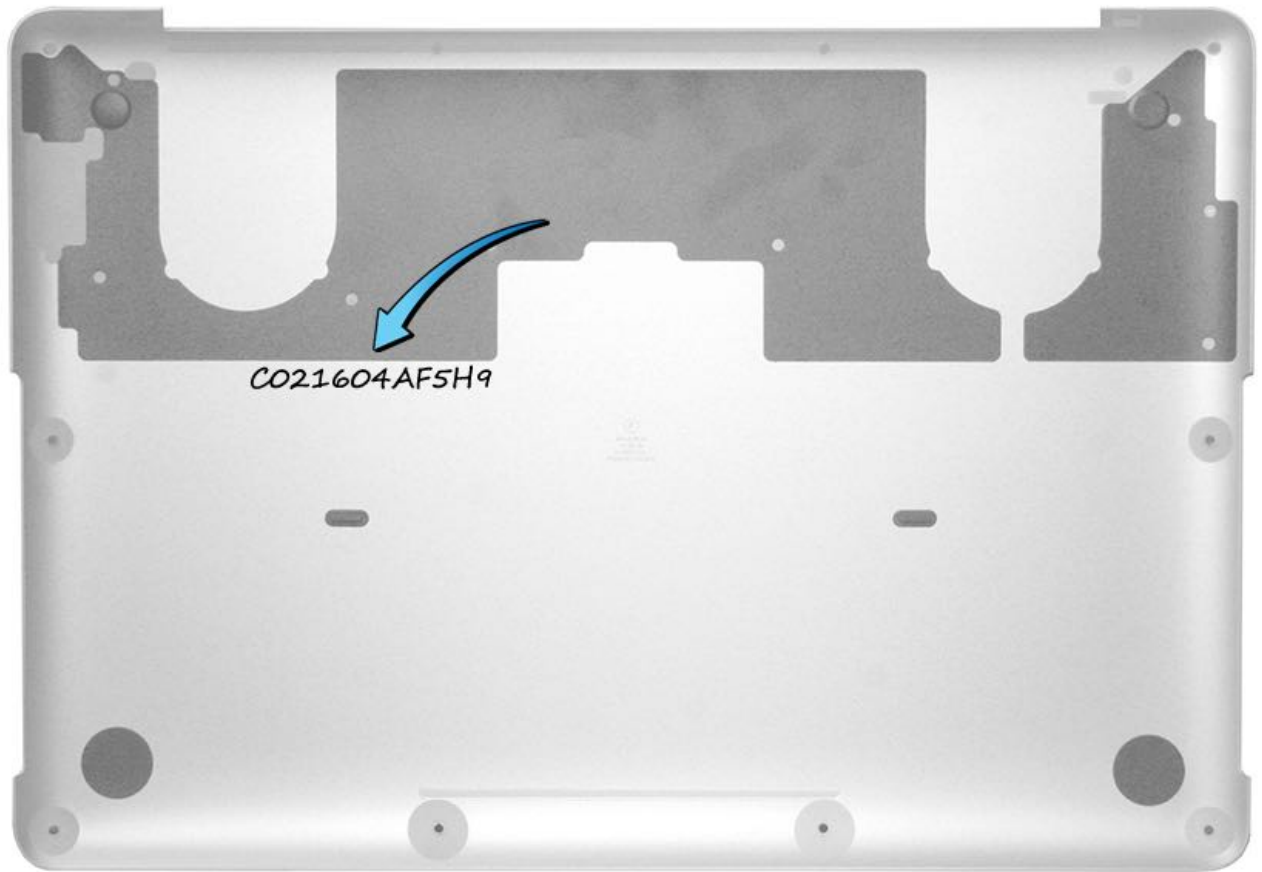
### MacBook Pro (Retina, 13-inch, Early 2015) Serial Number Location

With the bottom case removed, find the system serial number label affixed to the top case frame under the right speaker.



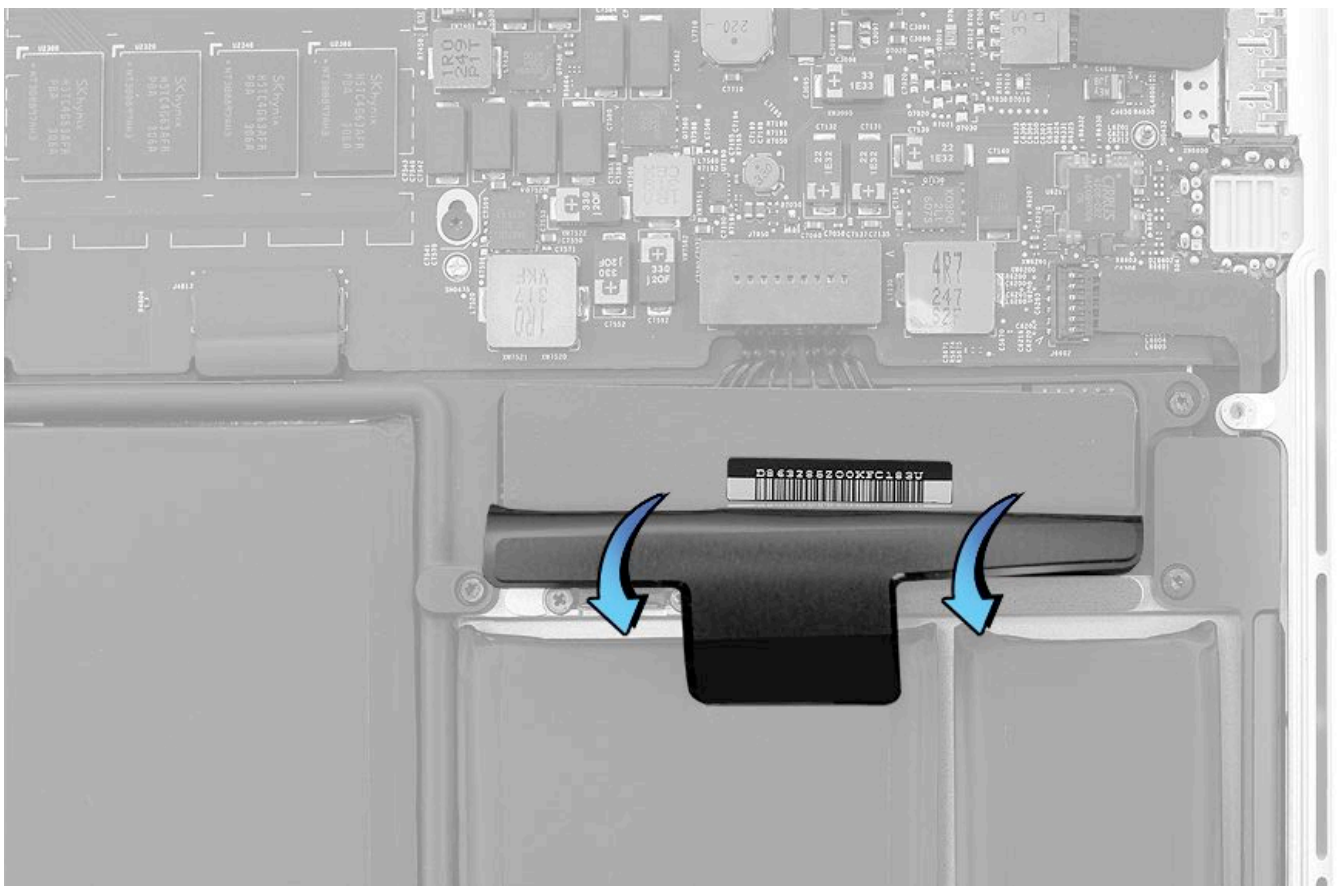
### Transferring the System Serial Number

When replacing a bottom case, retain the user's original bottom case until the repair is complete. Before installing EITHER a replacement top case or bottom case, use a fine-tipped permanent marker to write the original system serial number inside the bottom case.



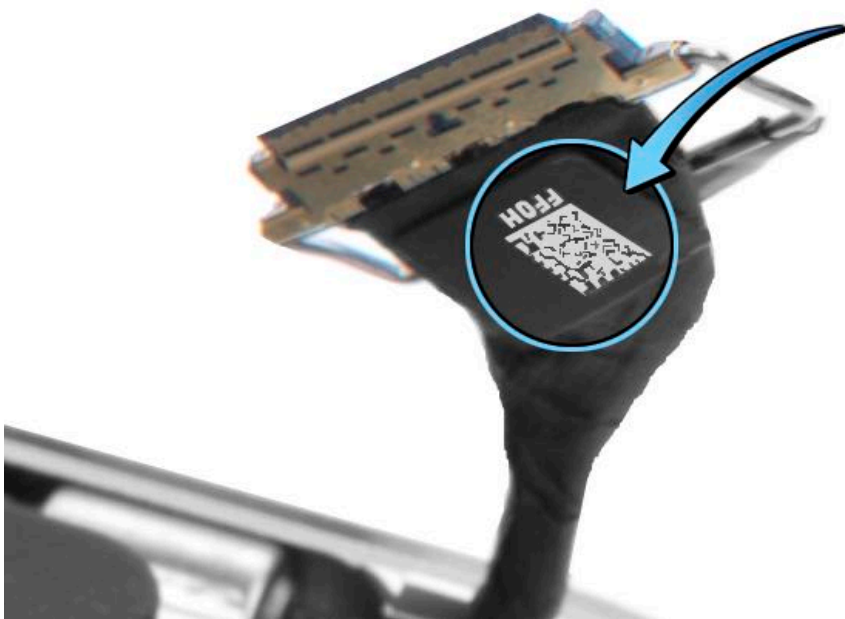
### Battery Serial Number

The battery serial number is located underneath the flap near the battery connector. Copy the original battery serial number when reporting a top case return to Apple.



### Display Assembly Serial Number

The display's serial number is located on the underside of the embedded DisplayPort (eDP) cable.



# Visual/Mechanical Inspection (VMI) Guide for Mac Computers - Table of Contents

## Visual/Mechanical Inspection (VMI) Guide for Mac Computers - Table of Contents

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- [Liquid Damage](#)
- [Power Adapters](#)
- [USB-C Cables](#)

# Liquid Contact Indicators

## Liquid Contact Indicators

Liquid Contact Indicators (LCIs) have been added to specific locations on current Mac portables to help determine if a computer has been exposed to liquid. Normally represented by small white dots, the LCIs turn red when they have come in contact with liquid, such as an accidental spill.

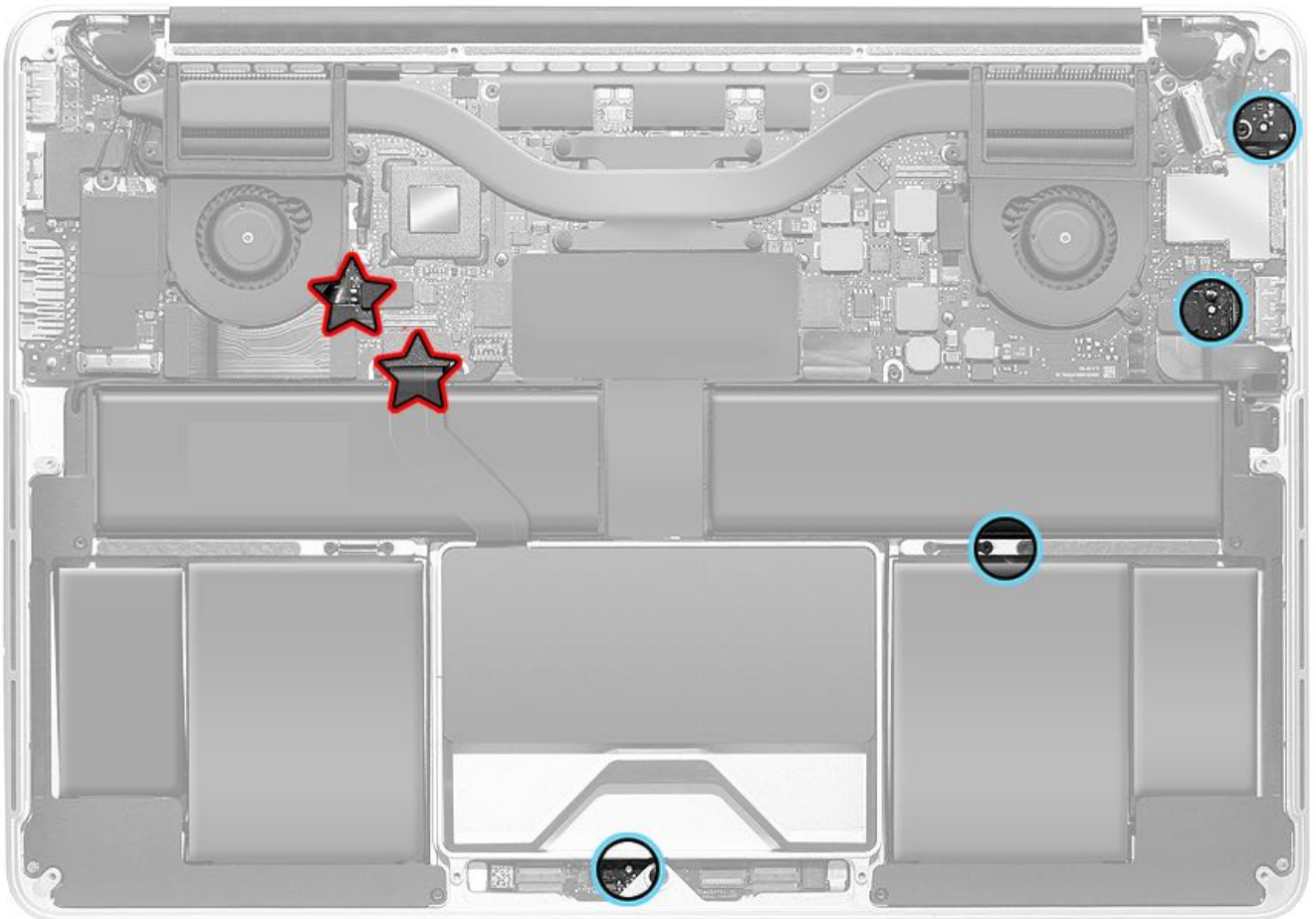
**Important:** The LCI is a tool that helps technicians identify whether or not a product has been in contact with liquid. Technicians should not rely solely on this tool, but should perform a thorough examination for signs of liquid contact, such as corrosion.

For more information, refer to article [HT204769: Mac computers: About liquid contact indicators \(LCIs\) and warranty coverage](#).

### Key

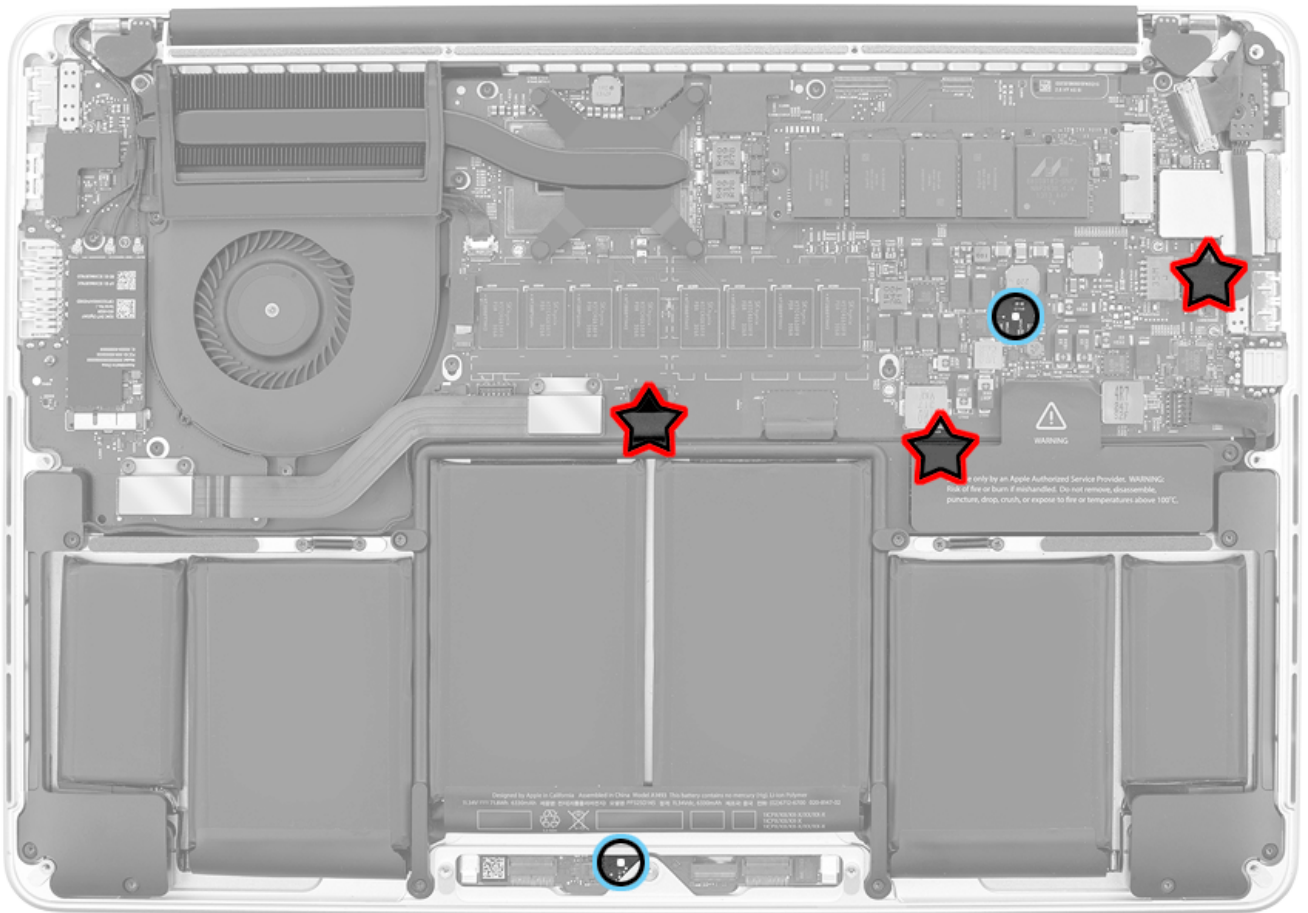
- **Circle:** LCI is visible with bottom case removed
- **Star:** LCI is hidden (under a module or cable)

### MacBook Pro (Retina, 13-inch, Late 2012 and Early 2013)

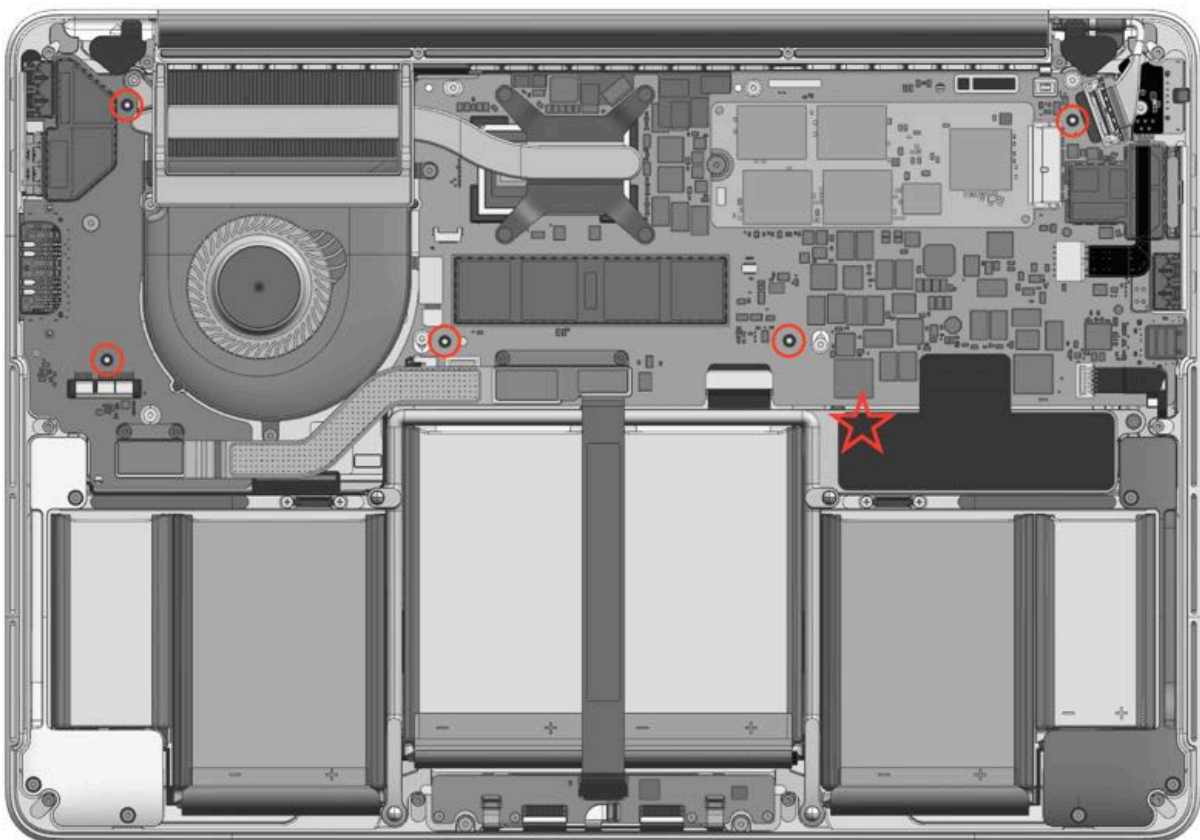


### MacBook Pro (Retina, 13-inch, Late 2013 and Mid 2014)





**MacBook Pro (Retina, 13-inch, Early 2015)**



# LCD Pixel Anomalies

When displaying a single color over the screen area, the LCD panel might show one or more pixels that are not properly lit.

LCD technology uses rows and columns of addressable points (pixels) that render text and images on the screen. Each pixel has three separate subpixels—red, green, and blue—that allow an image to render in full color. Each subpixel has a corresponding transistor responsible for turning that subpixel on and off.

Depending on the display size, there can be thousands or millions of subpixels on the LCD panel. For example, the LCD panel used in the iMac (27-inch, Late 2013) has a display resolution of 2560 by 1440, which means that there are 3.7 million pixels. Each pixel is made up of a red, a green, and a blue subpixel, resulting in over 11 million individual picture elements on the 27-inch display. Occasionally, a transistor may not work perfectly, which results in the affected subpixel remaining off (dark) or on (bright). With the millions of subpixels on a display, it is possible to have a low number of such transistors on an LCD. In some cases, a small piece of dust or other foreign material may appear to be a pixel anomaly. Apple strives to use the highest quality LCD panels in its products; however, pixel anomalies can occur in a small percentage of panels.

In some cases, pixel anomalies are caused by a piece of foreign material that is trapped somewhere inside the display or on the front surface of the display or glass panel. Foreign material is typically irregular in shape and is usually most noticeable when viewed against a white background.

- For any computer, foreign material on the outer surface of the display or glass panel can be easily removed using a lint-free cloth.
- For iMacs only, foreign material trapped between the glass panel and display should be removed by an Apple Authorized Service Provider or Apple Retail Store.
- For any computer, foreign material trapped inside the display can only be resolved by replacing the entire display assembly.

To determine if the display has an acceptable number of pixel anomalies, see the appropriate article:

- [HT202025: About LCD display pixel anomalies for Apple products released in 2010 and later](#)
- [HT201613: About LCD display pixel anomalies for Apple products released before 2010](#)



# General Troubleshooting

## Update Software and Firmware

**Important:** Before you begin troubleshooting, ensure the correct version of macOS is installed, and check for and apply the latest software and firmware updates. Computers sometimes exhibit symptoms that indicate the wrong version of macOS system software is installed. Check article [HT204319: macOS versions and builds included with Mac computers](#) to make sure system build is correct for this computer model.

Firmware is the name given to software that is written into memory circuits such as flash memory, that will hold the software code indefinitely, even when power is removed from the hardware. Firmware on Intel Mac computers is designed to be updated if necessary by running the macOS Software Update check (available in the Apple () menu) while the computer is connected to the Internet.

For more information about firmware updates, refer to article [HT201518: About EFI and SMC firmware updates for Intel-based Mac computers](#).

## Troubleshooting Techniques

For more information, go to [ATLAS](#) and enter “troubleshooting” in the search field.

## Hardware vs. Software

To isolate a hardware issue from a software issue, refer to article [HT203161: Isolating issues in macOS](#).

To troubleshoot a software issue, refer to the following articles:

- [HT201516: How to troubleshoot a software issue](#)
- [HT201861: About incompatible software on your Mac](#)
- [HT204323: If a flashing question mark appears when you start your Mac](#)
- [HT204904: How to reinstall macOS](#)
- [HT202574: Mac mini \(Late 2012 and later\), iMac \(Late 2012 and later\): About Fusion Drive](#)

# Quick Check Procedures

## Resetting the System Management Controller (SMC)

The System Management Controller (SMC) is a chip on the logic board that controls all power functions. If the computer is experiencing any power issue, such as not starting up, not displaying video, sleep issues, or fan noise issues, resetting SMC may resolve it.

For more information and instructions to reset the SMC on different computer models, refer to article [HT201295: Reset the System Management Controller \(SMC\) on your Mac](#).

**Note for iMacs:** If the power button is pressed while inserting the power cord, the iMac will enter a mode in which the fans run at full speed. For more information, refer to article [HT204463: iMac: Fans run at full speed after computer turns on](#).

## Resetting Non-Volatile RAM (NVRAM)

NVRAM stores certain system and device settings in a location that macOS can access quickly. Exactly which settings are stored in the computer's NVRAM varies depending on the type of computer as well as the types of devices and drives connected. To reset NVRAM:

1. Shut down the computer.
2. Locate the following keys on the keyboard: Command, Option (Alt), P, and R. You will need to hold these keys down simultaneously in Step 4.
3. Press power button.
4. Immediately press and hold Command-Option-P-R keys.  
**Important:** You must press this key combination before the gray screen appears.
5. Hold down keys until computer restarts, and you hear startup chime a second time.  
**Note:** For MacBook Pro (Late 2016 and 2017) and MacBook (Retina, 12-inch, 2017), hold down keys for at least 20 seconds. There is no startup chime.
6. Release keys.

**Note:** After resetting NVRAM, you might need to reconfigure settings for speaker volume, screen resolution, startup disk selection, and time zone information.

For more information, refer to article [HT204063: How to Reset NVRAM on your Mac](#).

## Starting Up in Safe Mode

Safe Mode (sometimes called Safe Boot) is a way to start up a Mac so that it performs certain checks and prevents some software from automatically loading or opening. These changes can help resolve or isolate certain issues on the startup disk.

Follow these steps to start up into Safe Mode:

1. Be sure the computer is shut down.
2. Press the power button.
3. Press and hold the Shift key.  
**Note:** The Shift key should be pressed as soon as possible after the power button is pressed.
4. Release the Shift key when you see the Apple logo appear on the screen. After the Apple logo appears, it may take longer than usual to reach the login screen. This is because the computer is performing a directory check as part of Safe Mode.
5. To leave Safe Mode, restart the computer without pressing any keys during startup.

For more information, refer to article [HT201262: Use Safe Mode to isolate issues with your Mac](#).

# Sleep Status Tips

The following portable Mac models do not have a sleep LED:

- MacBook Air (Late 2010 and later)
- MacBook Pro (Retina, Mid 2012 to Mid 2015)

To troubleshoot without a sleep LED:

- Connect a USB device that has a power-on or activity LED. As power is restored to the USB and the system wakes from sleep, the LED lights up.
- Press Caps Lock key multiple times to wake the computer from sleep.
- Open display and press an alphanumeric key to wake the computer from sleep.
- A computer that has been asleep for an extended period can consume the remaining charge of the battery. Restore power to the computer with known-good power adapter, and check that the MagSafe indicator light shows an in-progress battery charge. The computer will boot from a hibernation file and start up from where it left off.
- Resetting SMC instantly shuts down the computer, with some side effects:
  - If the computer is in sleep mode, it will reboot from a hibernation file.
  - If the computer is booted to OS X or macOS during the SMC reset, data from open applications can be lost.
  - If the computer is already shut down, there will be no side effects.

**Note:** Look for the MagSafe indicator light to momentarily switch from off to green as SMC is reset and re-establishes communication with power adapter, then change from green to orange if the battery needs a charge.

# Diagnostic Software

Depending on the model, use the following diagnostics:

	Apple Service Diagnostic (ASD)	Apple Hardware Test (AHT)
MacBook Pro (Retina, 13-inch, Late 2012)	<a href="#">3S155</a>	<a href="#">3A244</a>
MacBook Pro (Retina, 13-inch, Early 2013)	<a href="#">3S155</a>	<a href="#">3A244</a>
MacBook Pro (Retina, 13-inch, Late 2013)	<a href="#">3S162</a>	n/a
MacBook Pro (Retina, 13-inch, Mid 2014)	<a href="#">3S162</a>	n/a

**Important:** For models introduced before June 2013, use Apple Hardware Test (AHT). For models introduced in June 2013 or later, use Apple Diagnostics. For more information on Apple Diagnostics, refer to article [HT202731: Using Apple Diagnostics](#).

## Apple Service Toolkit (AST)

AST is a suite of diagnostic tools that checks Intel-based Mac hardware components, and provides detailed diagnostic logs for review. AST runs on a local server, managing multiple Ethernet clients via NetBoot.

**Note:** As of March 2015, all of these models can use AST, but not AST 2.

For more information, refer to:

- [OP476: Latest Apple Service Toolkit download links and documentation](#)
- [TP586: AST Reference Guide Table of Contents](#)

## Mac Resource Inspector (MRI)

MRI, which is part of AST, is a quick triage tool that checks for the presence of hardware and reports sensor readings. Sensors are located on a variety of parts, including cables, fans, storage devices, power supply, display panel, and logic board. Use MRI to help isolate failures and avoid unnecessary part replacements. MRI complements ASD, which is a more in-depth repair verification tool.

**Note:** If all AST tests pass and a component is still suspected of fault, then verify with other diagnostic tools.

# Diagnostic Software

## Apple Service Toolkit 2 (AST 2)

AST 2 is a cloud-based diagnostic system to help technicians triage and verify repairs for iOS devices and Mac computers released in June 2014 and later, except for MacBook Pro (Retina, Mid 2014). With AST 2, technicians initiate diagnostics wirelessly on a user's device using a Diagnostic Console (a web application on a Mac or iPad). Technicians are also able to view diagnostic results on the Diagnostic Console.

For more information, refer to:

- [OP476: Latest Apple Service Toolkit download links and documentation](#)
- [TP1105: AST 2 for Mac Reference Guide - Table of Contents](#)
- [TP1118: AST 2 for Mac Reference Guide - Table of Contents \(Retail\)](#)

## Apple Diagnostics

Apple Diagnostics is a customer-facing software tool that is built-in to all Mac computers released in June 2013 and later.

For more information, refer to:

- [HT202731: How to use Apple Diagnostics on your Mac](#)
- [HT203747: Apple Diagnostics: Reference codes](#)

# Thermal and Electrical Sensors

Reference the tables below for MacBook Pro (Retina, 13-inch, Late 2012, Early 2013, Late 2013, Mid 2014, Early 2015) sensor information.

**Thermal Sensor Table**

SMC Name	Location	Diagnostic Name	Repair Suggestion
TB0T	Battery	Battery TS_MAX	Excessive internal battery temperature, damaged interposer board, or open/damaged BMU or logic board contacts.
TB1T	Battery	Battery TS1	Excessive internal battery temperature, damaged interposer board, or open/damaged BMU or logic board contacts.
TB2T	Battery	Battery TS2	Excessive internal battery temperature, damaged interposer board, or open/damaged BMU or logic board contacts.
TA0P	Logic Board, near flash storage	Fanwell Airflow	Excessive air intake area temperature or logic board sensor near air intake is damaged or disconnected from SMC.
TC0C	Logic Board, CPU	CPU die - Digital Core 0	Excessive CPU temperature or CPU sensor is damaged.
TC0P	Logic Board, near CPU	CPU Proximity	Excessive CPU temperature or logic board sensor near CPU is damaged or disconnected from SMC.
TC1C	Logic Board, CPU	CPU die - Digital Core 1	Excessive CPU temperature or CPU sensor is damaged.
Th1H	Logic Board, near Left Fin Stack	Left Fin Stack Proximity	Excessive heat sink fin stack temperature or fin stack proximity sensor on logic board is damaged. Verify fan is operational for proper cooling.
THSP	Logic Board, near Right Fin Stack	Thunderbolt Die	Excessive heat sink temperature or logic board sensor is damaged or disconnected from SMC. Verify fan is operational for proper cooling.
TM0P	Logic Board, near Memory	DDR3 Proximity	Excessive memory area temperature or logic board sensor near memory is damaged or disconnected from SMC.
TPCD	Logic Board, Platform Controller Hub (PCH)	PCH Die	Excessive PCH temperature or internal CPU sensor is damaged or disconnected from SMC.
Ts0P	Trackpad	Palm Rest	Excessive internal or enclosure temperature, IPD flex cable damage, or disconnected from logic board.
Ts1P	On trackpad actuator	Actuator	Excessive internal or enclosure temperature, IPD flex cable damage, or disconnected from logic board.
Tw0P	On I/O Board, bottom side, near Thunderbolt connector	Wireless Proximity	Excessive wireless card temperature or connections to wireless card via I/O board and I/O flex cable are damaged or disconnected from logic board and SMC.

**Electrical Sensor Table**

SMC Name	Location	General Description	Diagnostic Name	Repair Suggestion
IBLC	Logic Board	Current: LCD Backlight	LCD Backlight Current	Out of range LCD backlight current found or open signal to SMC.
IC0C	Logic Board	Current: CPU Core	CPU Icore	Out of range CPU current found or open signal to SMC.
IC0R	Logic Board	Current: CPU High (Core/AXG/DDR3/IO/SA)	CPU Computing	Out of range CPU current found or open signal to SMC.
IC1C	Logic Board	Current: PCH Core 1.05V	PCH Icore	Out of range current to PCH found or open signal to SMC.
IC2C	Logic Board	Current: CPU Core (IMON)	CPU IMON	Out of range CPU current found or open signal to SMC.
ICMC	Logic Board	Current: Camera S2	Camera	Out of range camera current found or open signal to SMC.

ID0R	Logic Board	Current: DC-In, MagSafe	DC-IN	Out of range DC-IN power current, defective MagSafe board or stuck pins or open signal to SMC. Connect correct model MagSafe adapter for battery charging.
IHSC	Logic Board	Current: Thunderbolt TBT (Default)	TBT	Out of range Thunderbolt controller current found or open signal to SMC. Disconnect Thunderbolt device(s) to determine logic board fault and/or substitute Thunderbolt device and cable to isolate fault.
ILDC	Logic Board	Current: LCD Panel	LCD Current	Out of range LCD panel current found or open signal to SMC.
IM0C	Logic Board	Current: LPDDR 1.2V (CPU & Memory)	DDR3 DRAM Only	Out of range memory current found or open signal to SMC.
IM1C	Logic Board	Current: CPU LPDDR 1.2V	DDR3 DRAM Only	Out of range memory current found or open signal to SMC.
IM2C	Logic Board	Current: LPDDR 1.8V (Memory)	DDR3 DRAM Only	Out of range memory current found or open signal to SMC.
IO3R	Logic Board	Current: Other 3.3V High	Other <3.3V>	Out of range I/O controller current found or open signal to SMC.
IO5R	Logic Board	Current: Other 5V High	Other <5V>	Out of range I/O controller current found or open signal to SMC.
IPBR	Logic Board	Current: Battery (BMON)	BATTERY	Out of range battery current found or open signal to SMC. Verify BMU Interconnect Screw is installed.
IR3C	Logic Board	Current: 3.3V S0	3.3V S0 Rail Current	Out of range logic board current found or open signal to SMC.
IR5C	Logic Board	Current: 5V S0	5V S0 Rail Current	Out of range logic board current found or open signal to SMC.
ISDC	Logic Board	Current: SSD	SSD 3.3V	Out of range SSD current found or open signal to SMC. Disconnect SSD/flash storage to verify logic board OK and/or substitute SSD to isolate fault.
ITPC	Logic Board	Current: Trackpad Actuator	Trackpad Actuator Current	Out of range trackpad actuator current found or open signal to SMC.
VC0C	Logic Board	Voltage: CPU Core	CPU Vcore	Out of range voltage to CPU found or open signal to SMC.
VD0R	Logic Board	Voltage: DC In (AMON)	DC In	Out of range voltage from MagSafe 2 found or open signal to SMC. Use correct MagSafe 2 AC power adapter and verify connector pins are clean and make good electrical connection.
VP0R	Logic Board	Voltage: P-Bus	PBUS Voltage	Out of range voltage from battery or charge circuitry found on logic board or open signal to SMC. Use correct MagSafe 2 AC power adapter and verify connector pins are clean and make good electrical connection. Recharge battery.
VTPC	Logic Board	Voltage: Trackpad Actuator	Trackpad Actuator Voltage	Out of range trackpad actuator voltage found or open signal to SMC.
ALSL	Display Assembly	Light Detection near FaceTime HD Camera	ALS	Out of range light detection or open signal from display clamshell connection (camera cable) to logic board. Possible interaction with trackpad temperature sensor (TS0P). Disconnect trackpad and retest Ambient Light Sensor (ALS) to logic board connections and communication with SMC. There exists an unlikely event that logic board motion sensor Accelerometer (MO_X) can interfere with ALS. If logic board accelerometer is also failing, disconnect camera cable to remove ALS and test to see if accelerometer still fails. Substitute known-good logic board or display clamshell to determine if fault is with logic board or display.

# Temperature Concerns

The normal operating temperature of this computer is well within national and international safety standards. Nevertheless, users may be concerned about generated heat. To prevent an unnecessary repair, compare a user's computer to a similar running model under similar load, if available at the repair site.

For more information, refer to articles

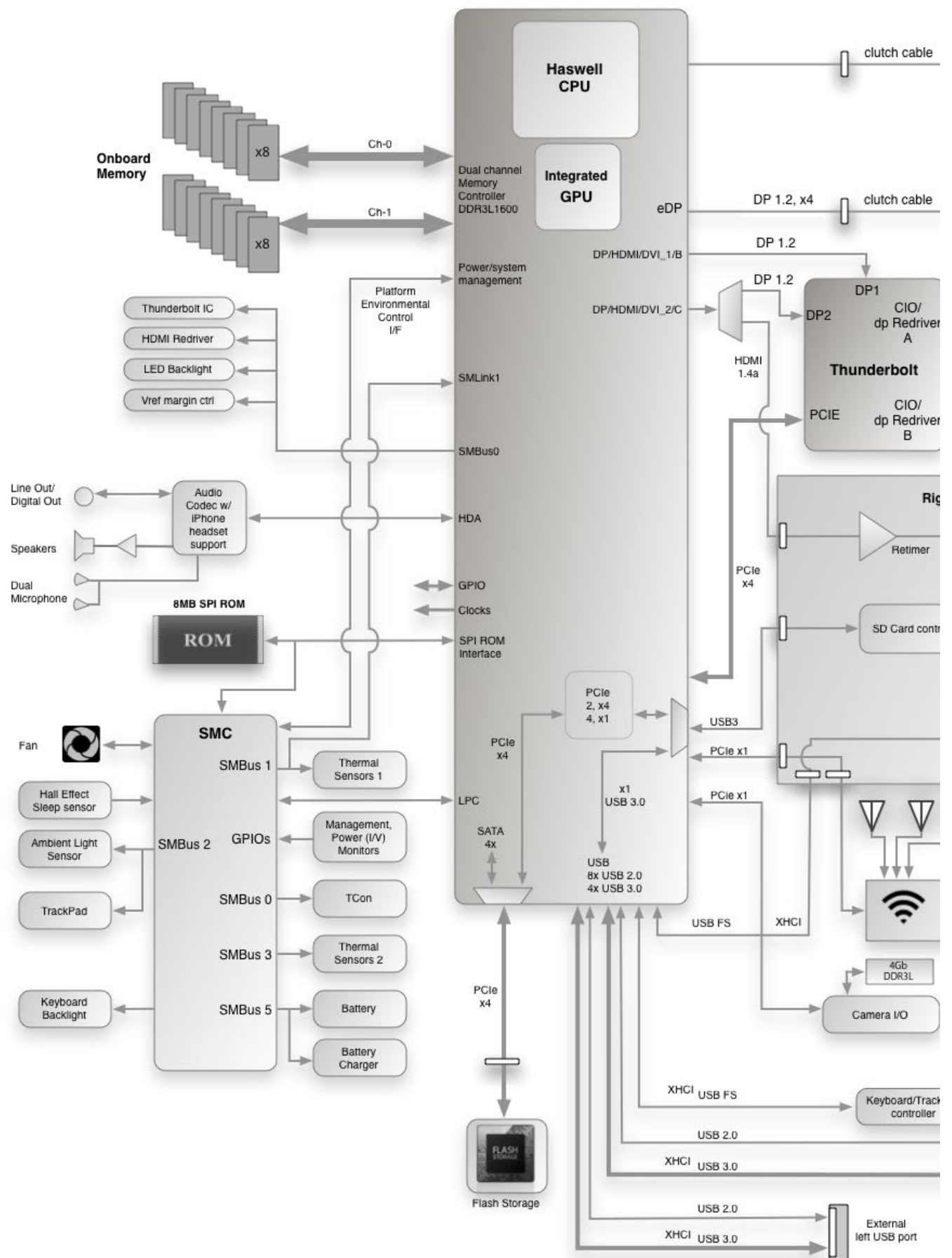
- [HT201640: Mac notebooks: Operating temperature](#)
- [HT203184: See how apps affect Mac performance, battery runtime, temperature, and fan activity](#)
- [HT202179: About fans and fan noise in your Mac](#)



# Block Diagram

## Block Diagram

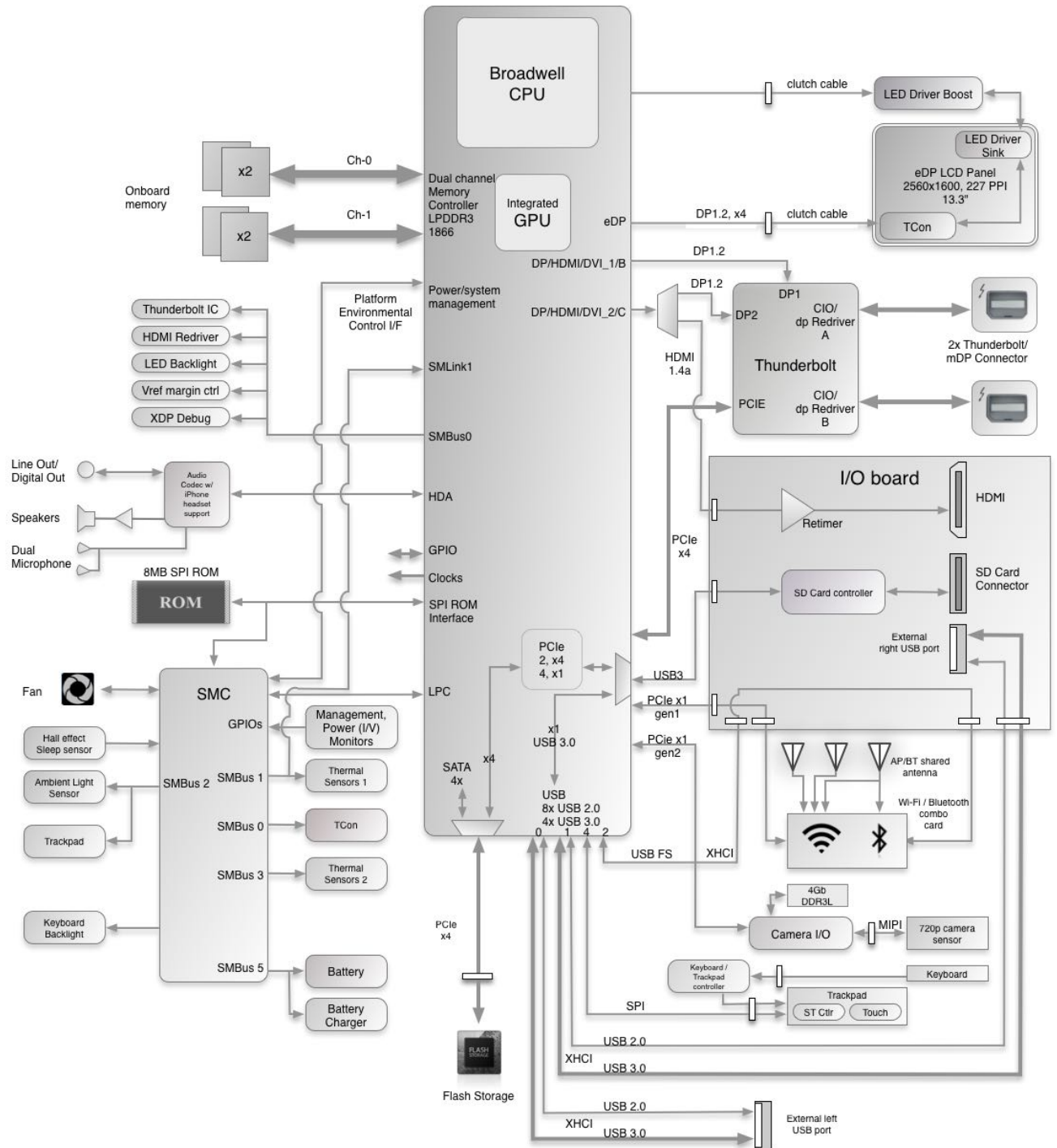
Refer to this diagram to see how modules are interrelated.



# Block Diagram

## Block Diagram for MacBook Pro (Retina, 13-inch, Early 2015)

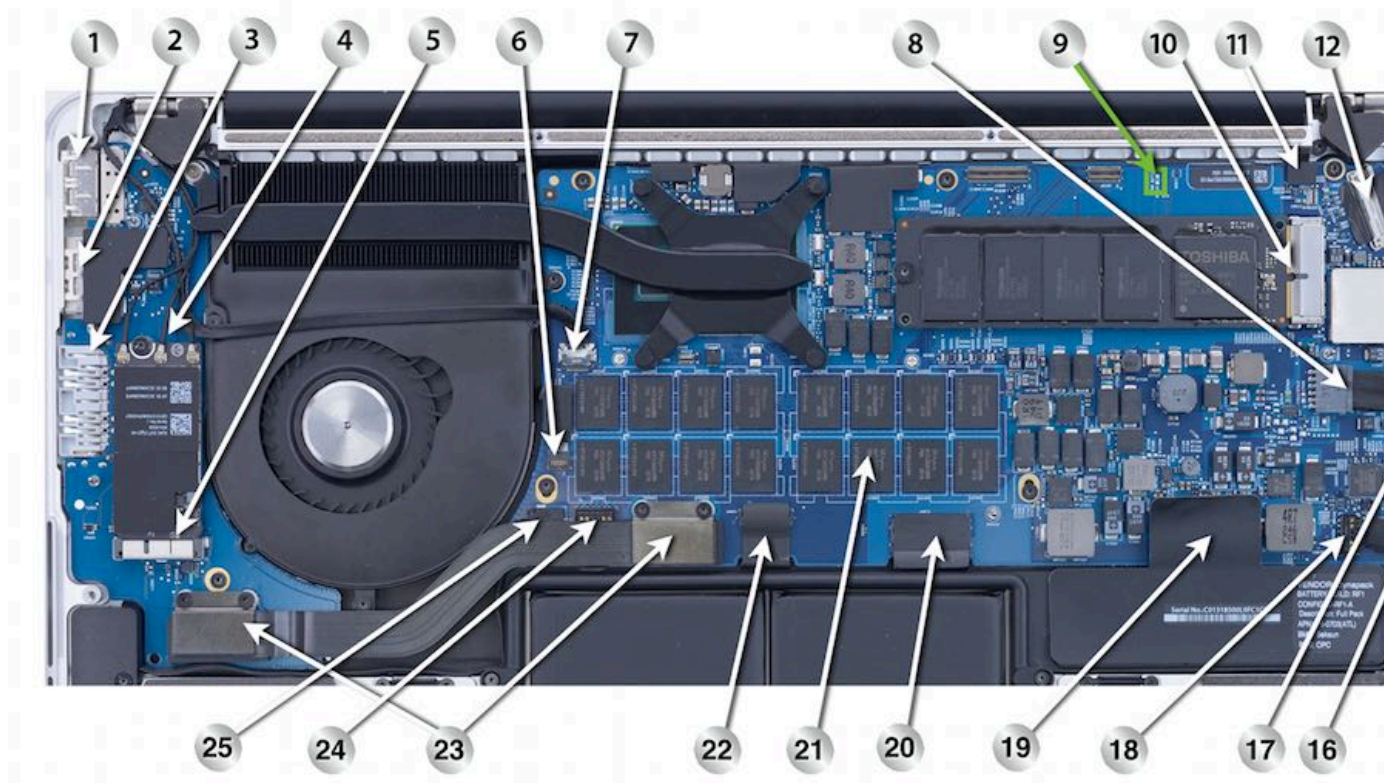
Refer to this diagram to see how modules are interrelated.



# Functional Overview

## Functional Overview

Refer to this diagram for symptoms related to logic board connectors.



### 1 = Right USB port

- USB device not found
- Controller not recognized
- USB driver issues
- USB power issues

### 2 = HDMI video

- HDMI controller not recognized
- No HDMI video
- No HDMI audio
- No power from HDMI port

### 3 = SD card slot

- No SD card recognized
- SD card insert issues

### 4 = Wi-Fi + Bluetooth antenna connectors

- No/poor Wi-Fi reception
- Drops Wi-Fi connection
- No pairing with Bluetooth devices
- Drops Bluetooth connection

### 5 = Wireless Card

- Wi-Fi service cannot be enabled
- Bluetooth service cannot be enabled

### 6 = Fan

- Fan not running
- Noisy fan perception

- Intermittent shutdown

#### **7 = FaceTime HD camera & Ambient Light Sensor (part of display assembly)**

- No camera video, blurred or monochrome video
- No dimming of display in low-light conditions
- Keyboard backlight cannot be enabled

#### **8 = MagSafe 2 (under logic board)**

- No power LED
- No battery charge

#### **9 = Power-on pads**

- Power on logic board if power button cannot

#### **10 = Flash storage card**

- Flash storage device not visible in System Information
- OS boot failure from internal flash storage

#### **11 = Keyboard backlight flex cable (part of top case)**

- No keyboard backlight

#### **12 = LCD/backlight**

- No video on LCD
- No display backlight
- Open backlight fuse

#### **13 = Thunderbolt ports**

- Thunderbolt device not found
- Thunderbolt controller not recognized
- Thunderbolt driver issue
- Thunderbolt power issues

#### **14 = Left USB port**

- USB device not found
- Controller not recognized
- USB driver issues
- USB power issues

#### **15 = Microphone**

- No internal audio input (with Internal Microphone selected in Sound Input Preferences)

#### **16 = Audio port (soldered on logic board)**

- No external analog audio/digital optical output
- No headset controls or microphone input

#### **17 = Sleep sensor (on bottom side of logic board)**

- No sleep when display closed
- No video to internal display, but video to external display if connected (sensor stuck)

#### **18 = Left speaker**

- No or distorted audio from left speaker

#### **19 = Battery**

- Not running when on battery only
- Not charging (verify with correct model of power adapter)
- X symbol for battery in menu bar
- Battery removed - extended time before boot chime and fan running at full speed

#### **20 = Keyboard flex cable**



- No power on from keyboard
- Non-responsive keys

**21 = Onboard memory (soldered on logic board)**

- Three beep tones on startup
- Freeze or kernel panic
- Horizontal video lines

**22 = Trackpad/trackpad button/thermal sensor**

- No multi-touch or cursor movement
- No click action
- Trackpad thermal sensor input missing - fan running at full speed

**23 = I/O flex cable**

- No right USB power
- No HDMI video
- No SD card slot

**24 = Right speaker**

- No or distorted audio from right speaker

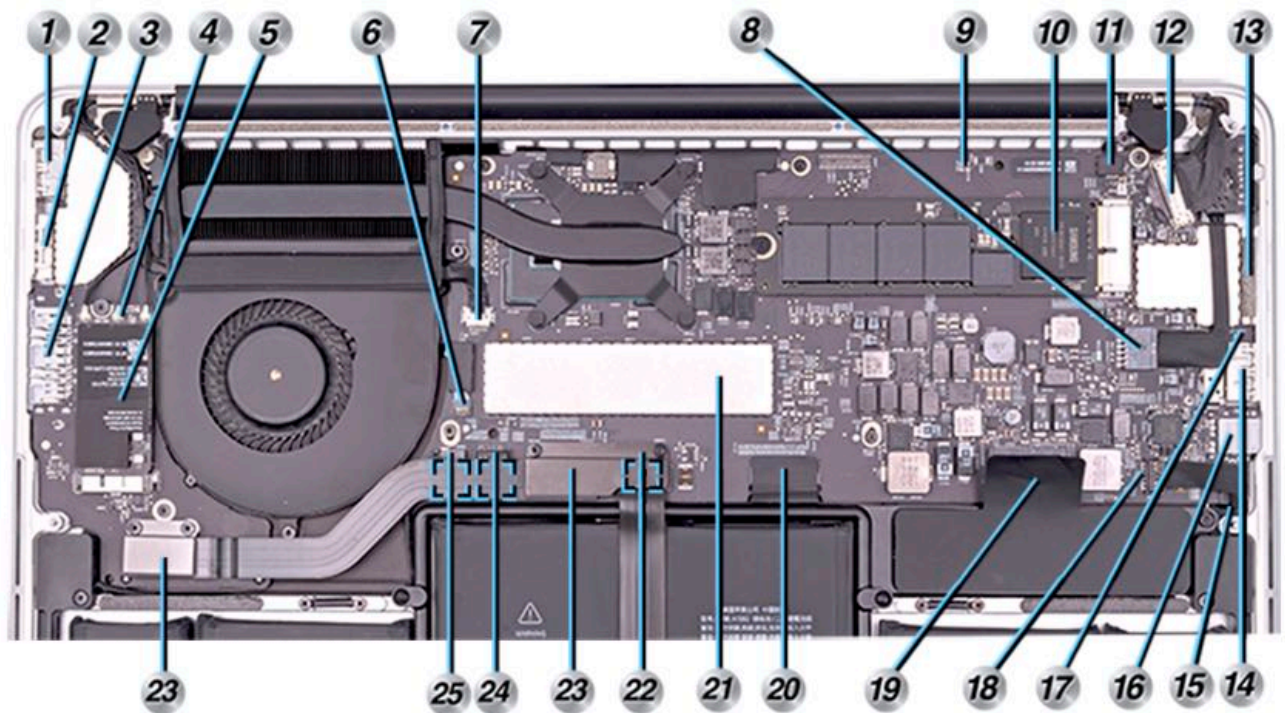
**25 = I/O coax cable (between I/O board and logic board connector)**

- Right USB port issues
- No HDMI video
- No SD card slot

# Functional Overview

## Functional Overview

Refer to this diagram for symptoms related to MacBook Pro (Retina, 13-inch, Early 2015) logic board connectors.



### 1 = Right USB port

- USB device not found
- Controller not recognized
- USB driver issues
- USB power issues

### 2 = HDMI video

- HDMI controller not recognized
- No HDMI video
- No HDMI audio
- No power from HDMI port

### 3 = SD card slot

- No SD card recognized
- SD card insert issues

### 4 = Wi-Fi + Bluetooth antenna connectors

- No/poor Wi-Fi reception
- Drops Wi-Fi connection
- No pairing with Bluetooth devices
- Drops Bluetooth connection

### 5 = Wireless card

- Wi-Fi service cannot be enabled
- Bluetooth service cannot be enabled

### 6 = Fan

- Fan not running
- Noisy fan perception
- Intermittent shutdown

#### **7 = FaceTime HD camera & Ambient Light Sensor (part of display assembly)**

- No camera video, blurred or monochrome video
- No dimming of display in low-light conditions
- Keyboard backlight cannot be enabled

#### **8 = MagSafe 2 (under logic board)**

- No power LED
- No battery charge

#### **9 = Power-on pads**

- When shorted with a flat-blade screwdriver, these pads on logic board will turn on computer if power on button cannot

#### **10 = Flash storage card**

- Flash storage device not visible in System Information
- OS boot failure from internal flash storage

#### **11 = Keyboard backlight flex cable (part of top case)**

- No keyboard backlight

#### **12 = LCD/backlight**

- No video on LCD
- No display backlight
- Open backlight fuse

#### **13 = Thunderbolt ports (2)**

- Thunderbolt device not found
- Thunderbolt controller not recognized
- Thunderbolt driver issue
- Thunderbolt power issues

#### **14 = Left USB port**

- USB device not found
- Controller not recognized
- USB driver issues
- USB power issues

#### **15 = Microphone**

- No internal audio input (with Internal Microphone selected in Sound Input Preferences)

#### **16 = Audio port (soldered on logic board)**

- No external analog audio/digital optical output
- No headset controls or microphone input

#### **17 = Sleep sensor (on bottom side of logic board)**

- No sleep when display closed
- No video to internal display, but video to external display if connected (sensor stuck)

#### **18 = Left speaker**

- No or distorted audio from left speaker

#### **19 = Battery**

- Not running when on battery only
- Not charging (verify with correct model of power adapter)
- X symbol for battery in menu bar
- Battery removed - extended time before boot chime and fan running at full speed

#### **20 = Keyboard flex cable**

- Will not turn on from keyboard
- Non-responsive keys

**21 = Onboard memory (soldered on logic board)**

- Three beep tones on startup
- Freeze or kernel panic
- Horizontal video lines

**22 = Trackpad flex cable**

- No Multi-Touch or cursor movement from built-in trackpad
- No click action from built-in trackpad
- Trackpad thermal sensor input missing - fan running at full speed

**23 = I/O flex cable (between I/O board and logic board connector)**

- Right USB port issues
- No right USB power
- No HDMI video
- No SD card slot
- Wi-Fi service cannot be enabled
- Bluetooth service cannot be enabled

**24 = Right speaker**

- No or distorted audio from right speaker

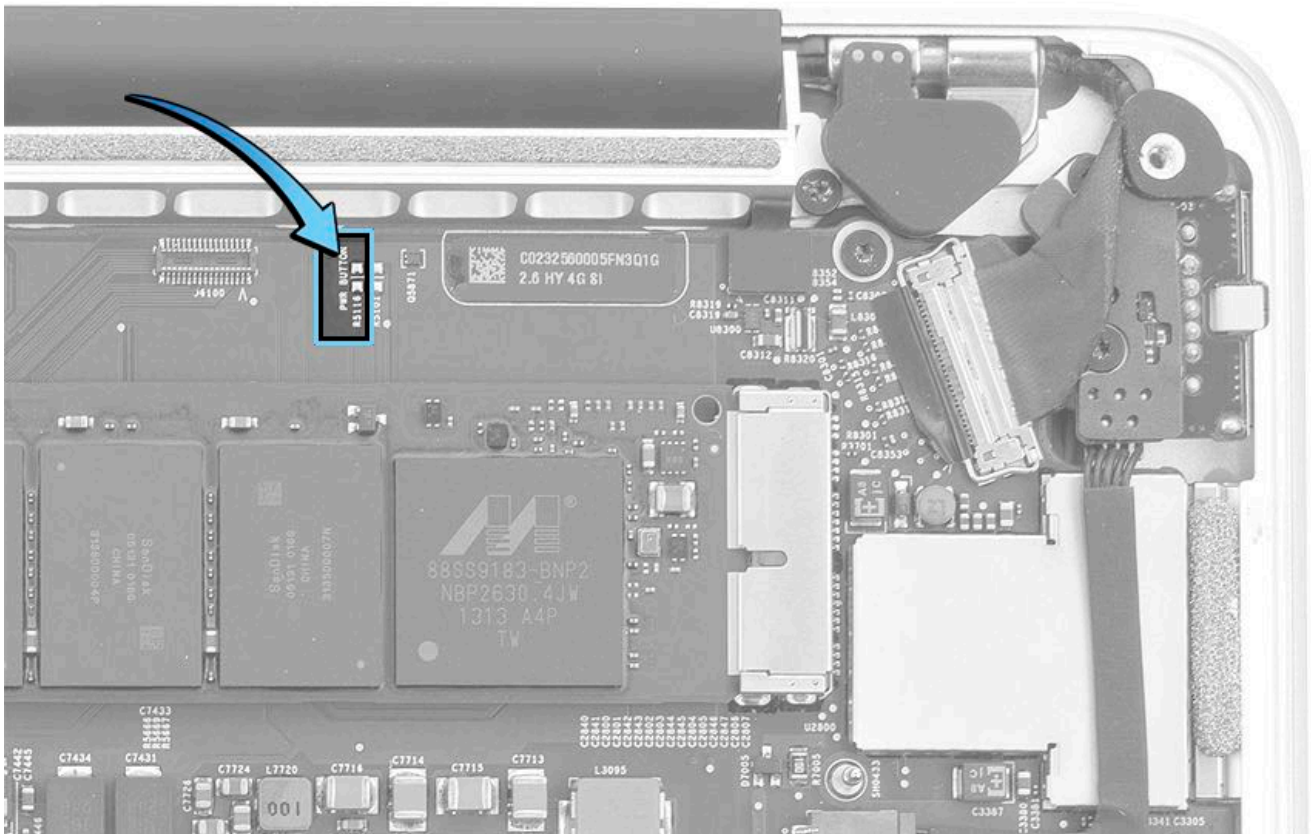
**25 = I/O coax cable (between I/O board and logic board connector)**

- Right USB port issues
- No right USB power
- No HDMI video
- No SD card slot
- Wi-Fi service cannot be enabled
- Bluetooth service cannot be enabled

## Logic Board Power-On Pads

If troubleshooting requires a need to start up a MacBook Pro (Retina, 13-inch, Late 2013, Mid 2014, or Early 2015) using the power-on pads, follow these steps:

1. Remove the bottom case.
2. Visually locate power-on pads on logic board.
3. Using a jeweler's flat-blade screwdriver, touch power-on pads to power on the logic board.  
**Caution:** Avoid touching anything other than the two (2) power-on pads. Doing so could damage the logic board.
4. Listen for startup sound and/or fan operation to confirm power turns on.





# Becoming Qualified for MacBook Pro (Retina, 13-inch, Late 2012 to Early 2015) Repairs

## Overview

There may be additional requirements to service any of the following products:

- MacBook Pro (Retina, 13-inch, Late 2012)
- MacBook Pro (Retina, 13-inch, Early 2013)
- MacBook Pro (Retina, 13-inch, Late 2013)
- MacBook Pro (Retina, 13-inch, Mid 2014)
- MacBook Pro (Retina, 13-inch, Early 2015)

Some technicians must pass the following Service Qualification Exam in addition to the Apple Certified Mac Technician (ACMT) exams:

- MacBook Pro (Retina, 13-inch, Late 2012 to Early 2015) Qualification Exam (9L0-S03)

**Note:** Passing this one exam will qualify technicians to service all models listed above.

This requirement ensures that technicians will service these models correctly and provide users with the best possible experience.

## Important:

- Technicians who have passed any previous version of the 9L0-S03 exam will be automatically qualified to service all models of MacBook Pro (Retina, 13-inch). They do not need to retake the exam.
- Technicians who passed previous exam versions are expected to review the most up to date service training course for MacBook Pro (Retina, 13-inch) before attempting a repair.
- Technicians with certain ACMT certifications are not required to take this exam, but may need to meet other requirements. See the “Additional Resources” section below for more information.

## Additional Resources

For more detailed information about certifications and training, see article [HT205332: About AppleCare Service Certifications](#).

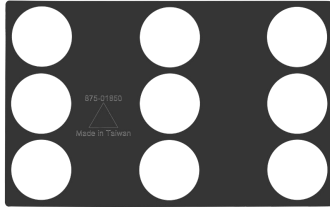
Questions about exams or online course can be addressed to [svc.trng@apple.com](mailto:svc.trng@apple.com).

# Trackpad Calibration Check

For video instruction, refer to article [SV279: Force Touch Trackpad Calibration Check Video](#).

## Required tools:

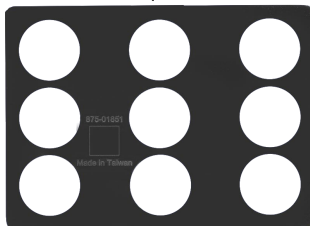
- Weight Placement Rubber Template (923-00555)
  - MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017)



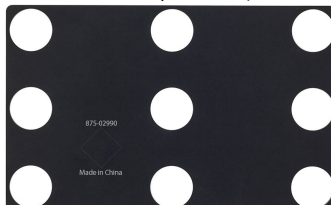
- Weight Placement Rubber Template (923-01316)
  - MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports)
  - MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports)



- Weight Placement Rubber Template (923-00599)
  - MacBook Pro (Retina, 13-inch, Early 2015) and (Retina, 15-inch, Mid 2015)



- Weight Placement Rubber Template (923-01317)
  - MacBook Pro (15-inch, 2016 and 2017)



**Note:** Weight Placement Rubber Templates come in a pack of three. If the edges start to curl, it is necessary to order a new pack.

- 200g and 800g weights (923-00462)



## Steps:

To verify that the trackpad is responding as expected, the technician must run the Trackpad Calibration Check after every repair or whenever the computer has been reassembled.

**Note:** It is recommended to also run the Trackpad Response test after a top case with keyboard has been replaced, or if the user is having issues related to trackpad functionality.

1. Place the Weight Placement Rubber Template on the trackpad before launching the test in AST 2. This establishes the correct baseline for the weights.

**Important:** The Weight Placement Rubber Template does not need to be taped to the top case. Tape may cause inaccurate test results.



2. Launch AST 2. In Diagnostic Console, select Trackpad Calibration Check from the list of diagnostic suites. For more information on AST 2, refer to article [TP1279: AST 2: Supported Products and Tests](#).

**Caution:** The Trackpad Calibration Check is very sensitive to external disturbances. The test should be run on a flat surface. Do not run the diagnostic on a bench where other technicians are working. To avoid interfering with the results, be sure to place weights down gently on a separate surface while running the diagnostic. If the computer is bumped or jostled while the diagnostic is running, the technician will have to begin the test again.

[< Diagnostic Results](#)

# Diagnostic Suites

## TRIAGE



### Trackpad Response

Assists in verifying functionality of trackpad.



3 minutes



## REPAIR



### Trackpad Calibration Check

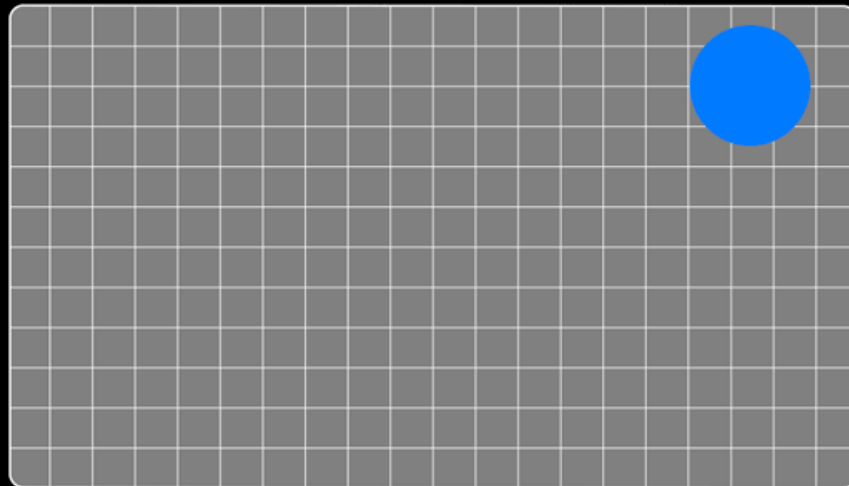
Verifies calibration of the trackpad actuator and force sensor.



3 minutes

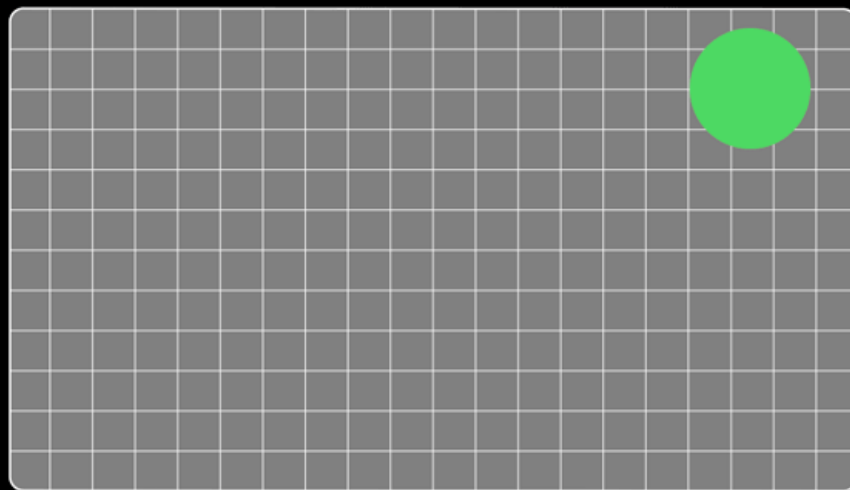


3. The diagnostic suite consists of several stages. The first stage of the suite is the Force Check, which is interactive and requires the technician to place the 200g and 800g weights as indicated. The blue dot will indicate where to place each weight on the trackpad. The text at the bottom of the screen will indicate which weight to use at each step. The dot will turn green when it is time to lift the weight from the trackpad.



#### Test Instruction

Place the 200g weight on the indicated area and press any key.



### Test Instruction

Remove the weight from the indicated area and press any key.

4. The next stage is the Actuator Check. During this stage, the trackpad will make clicking sounds while the actuator is tested. If any issues with the actuator are identified, the test may need to proceed to the next stage, which is the Actuator Calibration. The trackpad will continue to make clicking sounds while the actuator is calibrated. During this process, the unit under test (UUT) will display the screen shown below.

Checking your Mac...



Restart



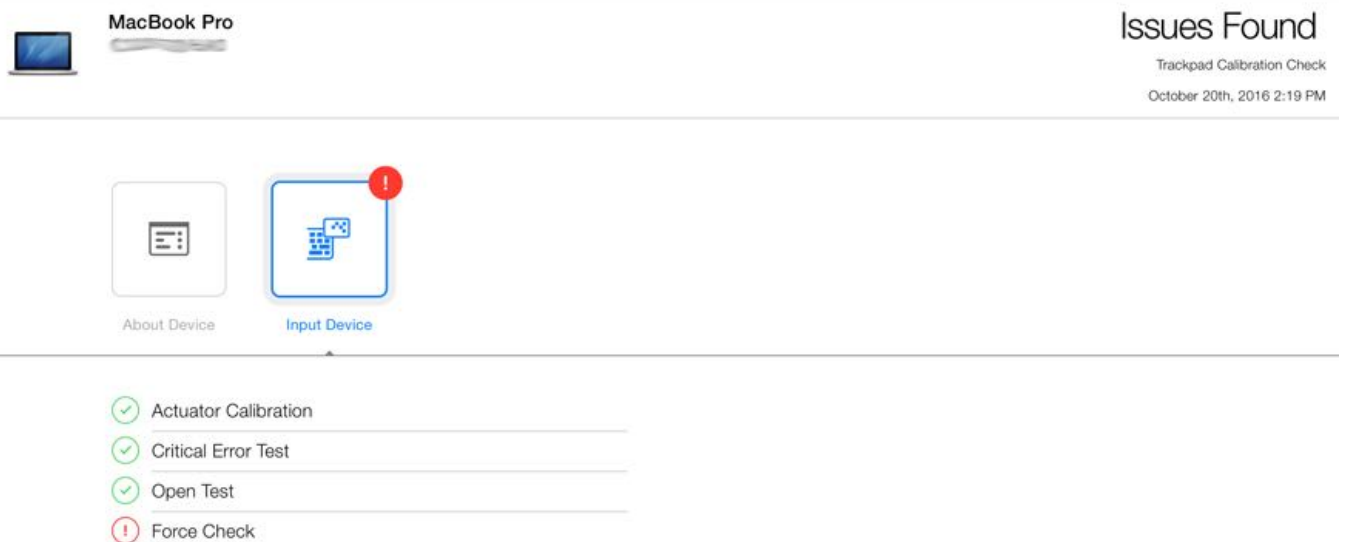
Shut Down

5. If no issues are found, the screen will look like the image below. The trackpad calibration is verified.





6. If issues were found in the Actuator Check, the Actuator Calibration, or the Force Check, the screen will look like the image below and the suite should be run again. If the computer fails a second time, a top case with keyboard replacement is recommended.



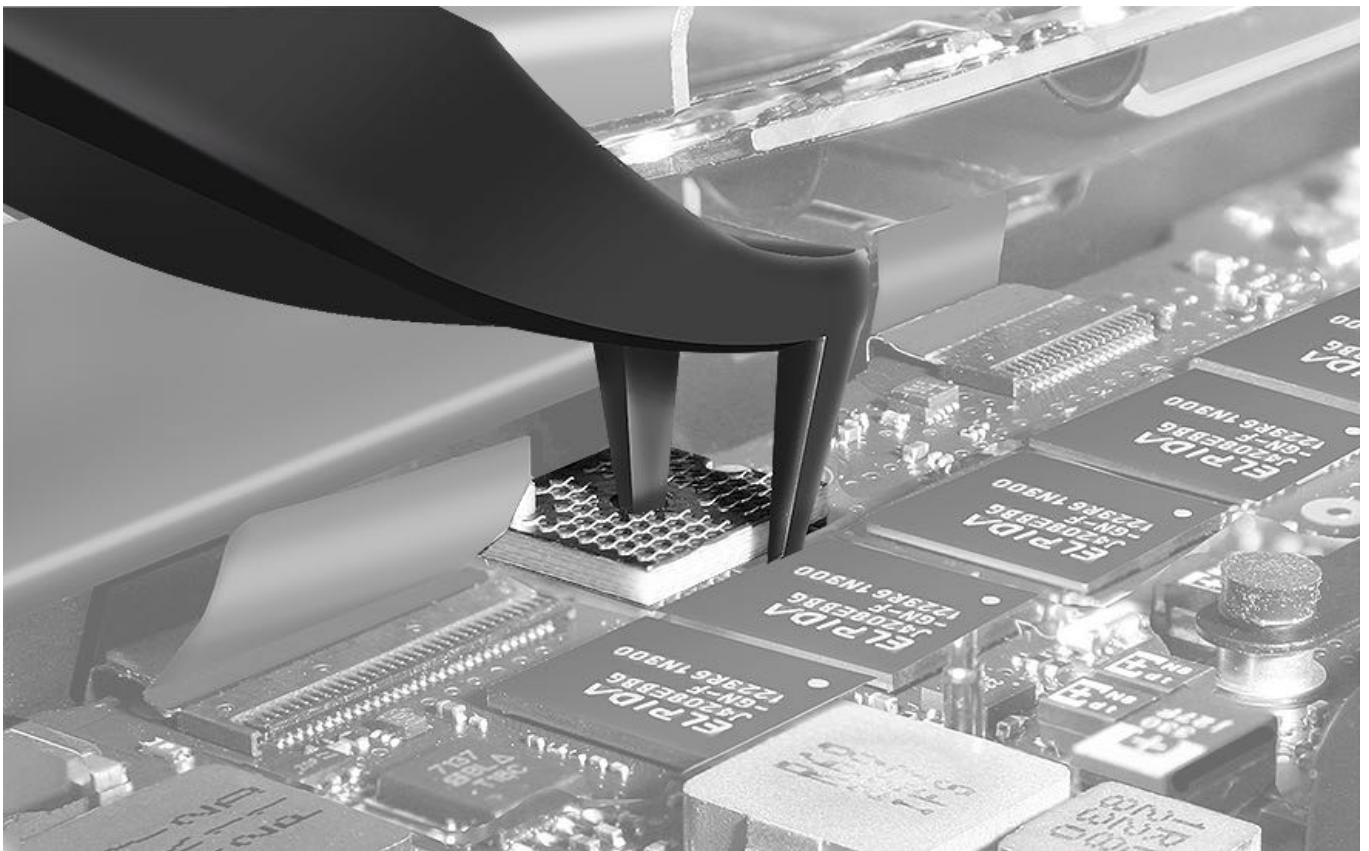
# Connector Types on Logic Board

## Interposer, MacBook Pro (Retina, 13-inch, Late 2012 and Early 2013)

- Only move interposer with the ESD-safe nonconductive interposer tweezers. Do not use other tweezers or other tools.
- When placing tweezer tips, do not touch or brush against gold pins on interposer.
- When temporarily removing interposer, place it in the clean compartment of a screw tray.
- If interposer appears intact, reuse it.
- Do not touch gold pads on logic board or underside of Battery Management Unit (BMU).
- Do not clean gold pads.
- Keep new interposer in shipping carrier until installation.
- Inspect interposer for damage such as missing/bent pins or lint/debris caught between the pins.
- If you need to replace the interposer, return used interposer in same shipping carrier that held the replacement interposer.
- For full details, refer to article [RP1020: Interposer](#).

Example:

- Interposer



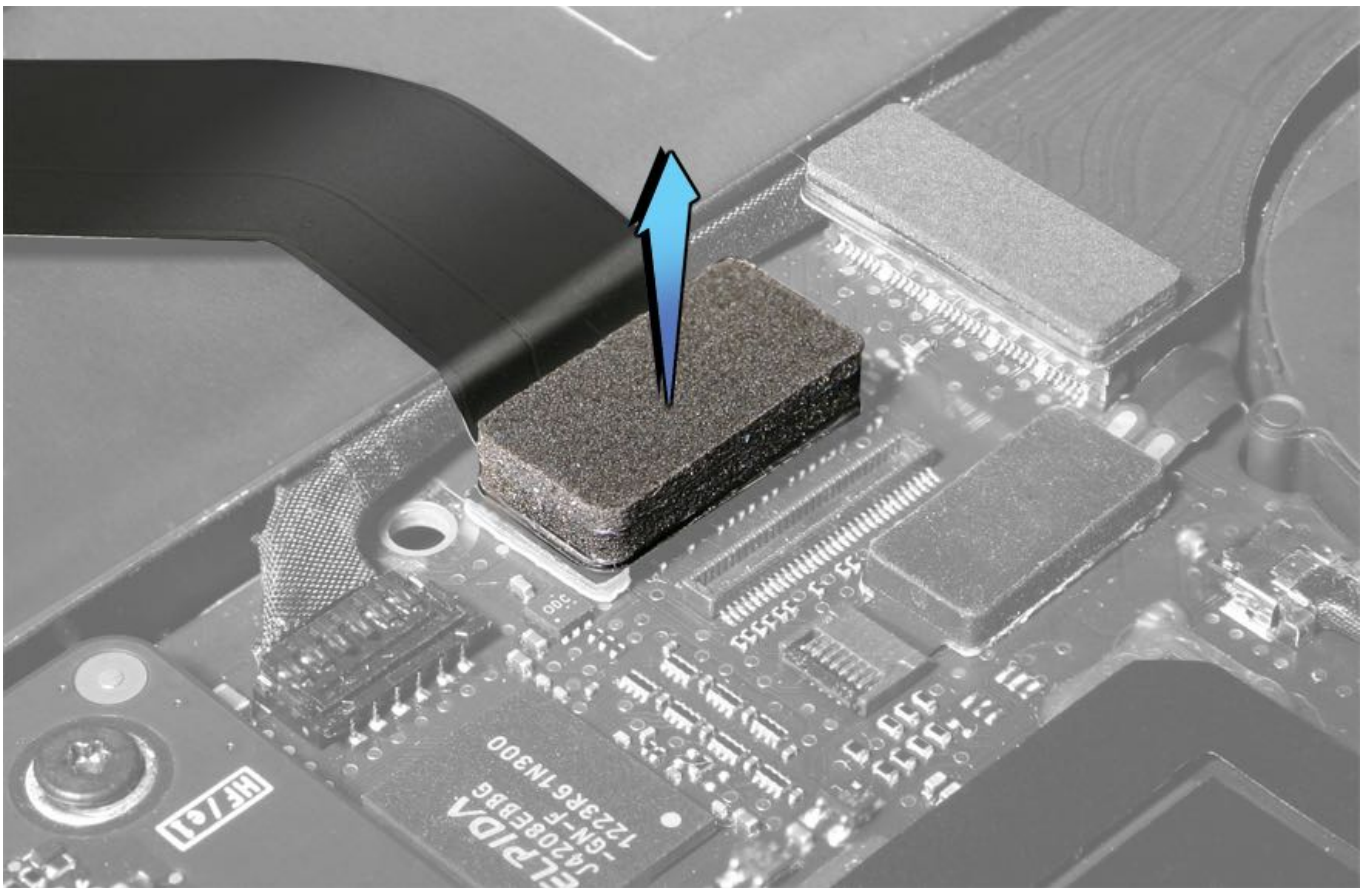
## Low-Profile Solid Platform Flex

- Disconnect connector vertically in one motion. The connectors are susceptible to bent pins if rocked side-to-side or inserted improperly.
- Reconnect connector by first aligning it over receptacle. Keep connector level with board and press down evenly.

Example:

- I/O flex cable
- audio board cable
- SSD (or flash storage) cable

[Low-Profile Solid Platform Flex Video](#)



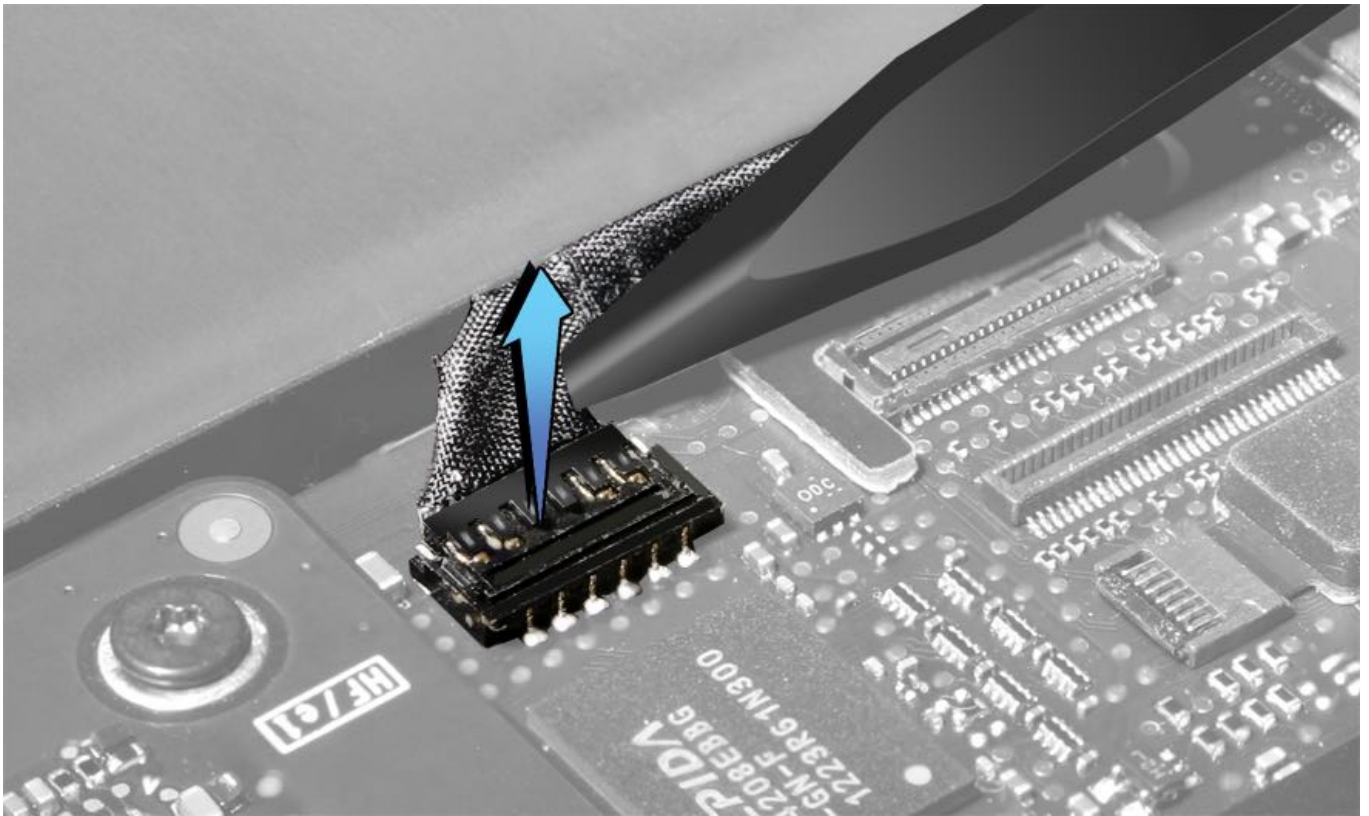
### Vertical Insert (JST)

- Slide black stick under cable. Stabilize connector with your finger and use black stick as a platform to disconnect cable vertically.
- Reconnect connector by first aligning its grooves to the pins in the receptacle. Keep connector level with board and slightly tip front side into receptacle.
- Check that connector is level (not tipped up) and is fully seated.

Example:

- speakers

[Vertical Insert \(JST\) Video](#)



### Locking Lever

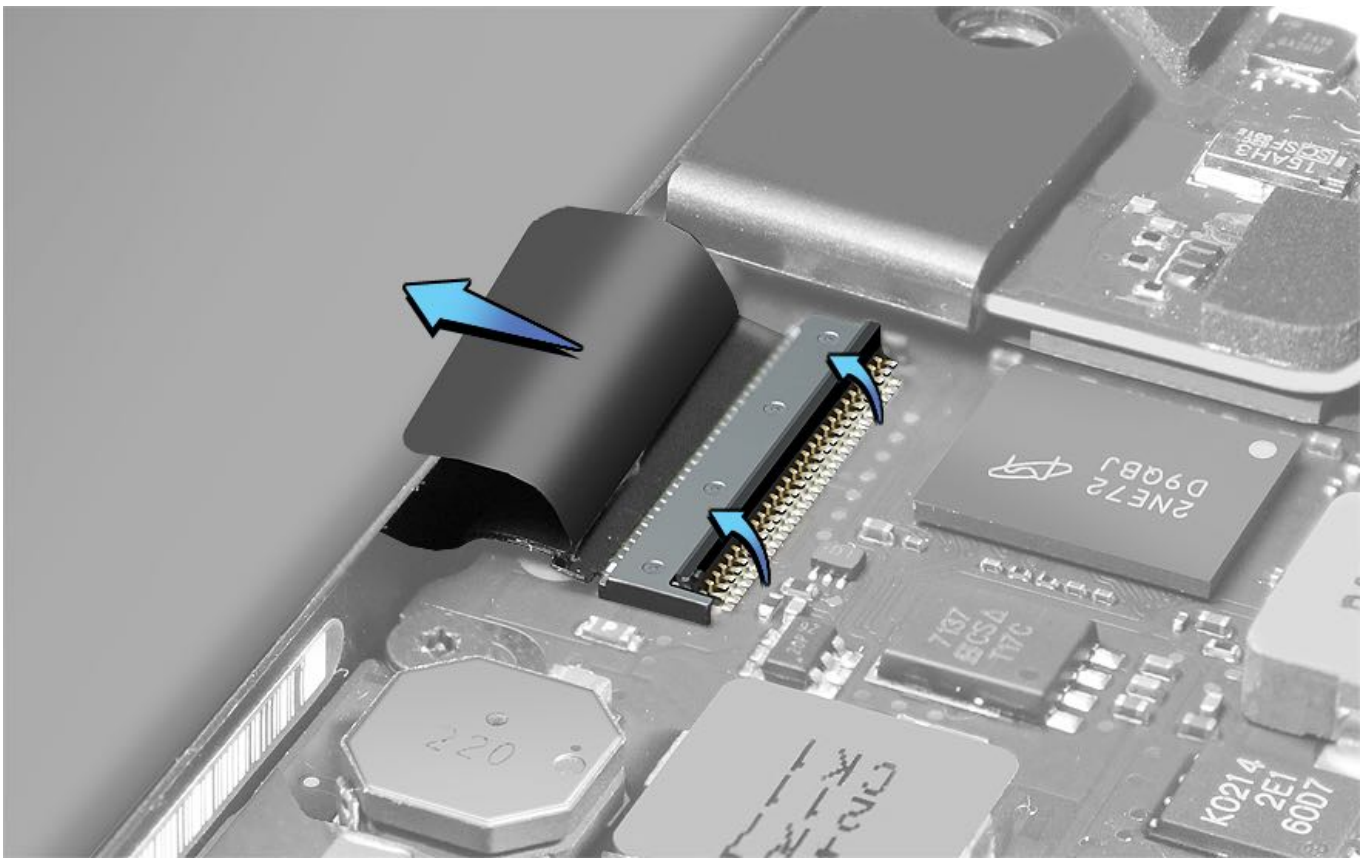
- Flip up lever 90 degrees and evenly disconnect cable.
- To ease pressure on cable connection, you can adhere ESD-safe Kapton tape to the cable to use as a pull tab.
- Use pull tab to slide cable straight into receptacle.
- Lock down lever after inserting cable.
- Remove ESD-safe Kapton tape, if used.
- Close lever when handling or shipping a logic board module, whether a known-good or a known-bad board.

Example:

- keyboard power-on button
- fans
- trackpad
- microphone

**Caution:** The locking levers on the logic board are fragile. To protect the levers during handling or shipment of the logic board, close the levers after the cables are disconnected. Once the logic board is installed in the top case and the cables are connected, be sure to lock down the levers again.

[Locking Lever Video](#)



#### **Thin, Multi-Pin Horizontal Insert: No Locking Bar**

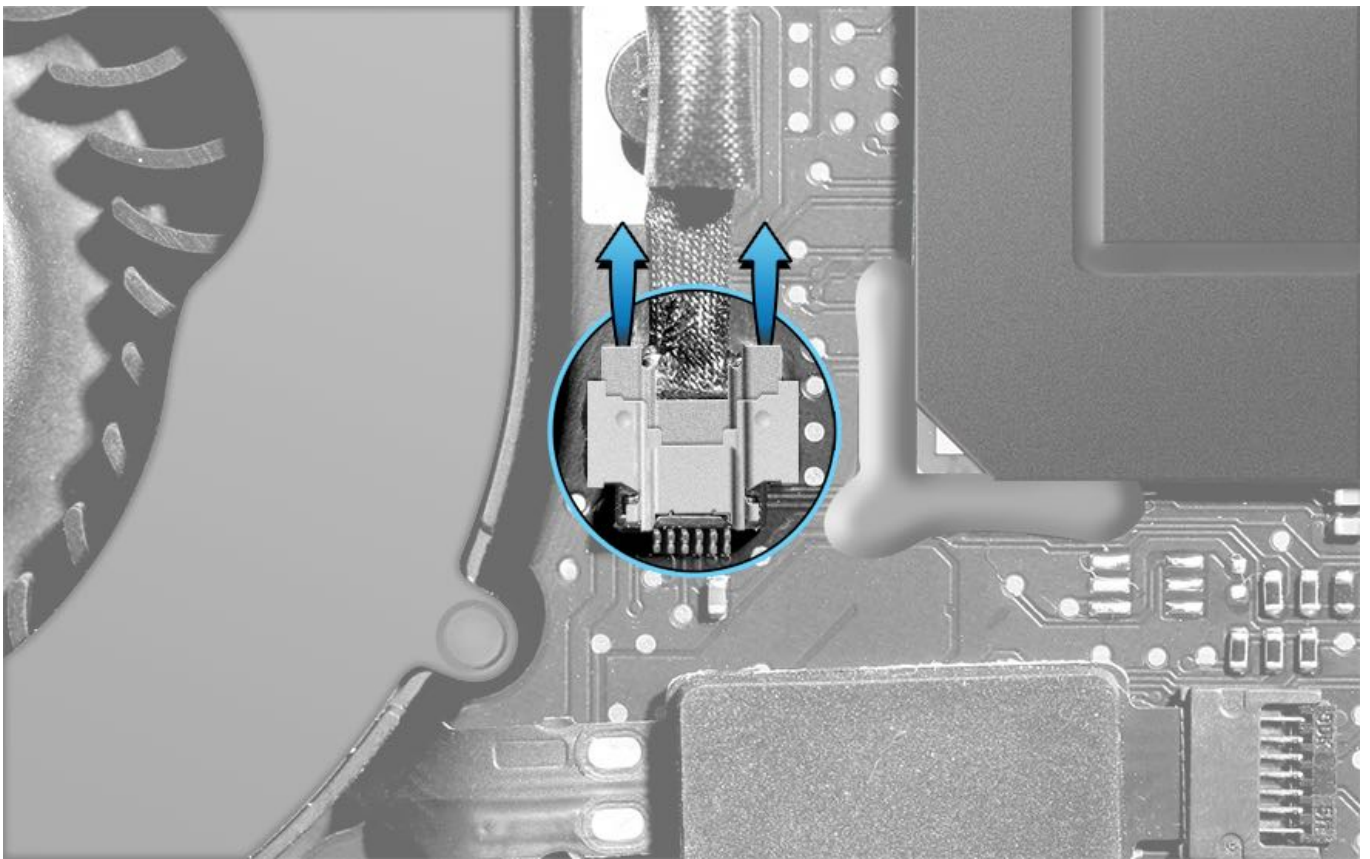
- Use black stick on alternating sides to evenly disconnect cable.
- Slide connector into receptacle on same horizontal plane as board.

Example:

- camera cable

[Thin, Multi-Pin Horizontal Insert Video](#)





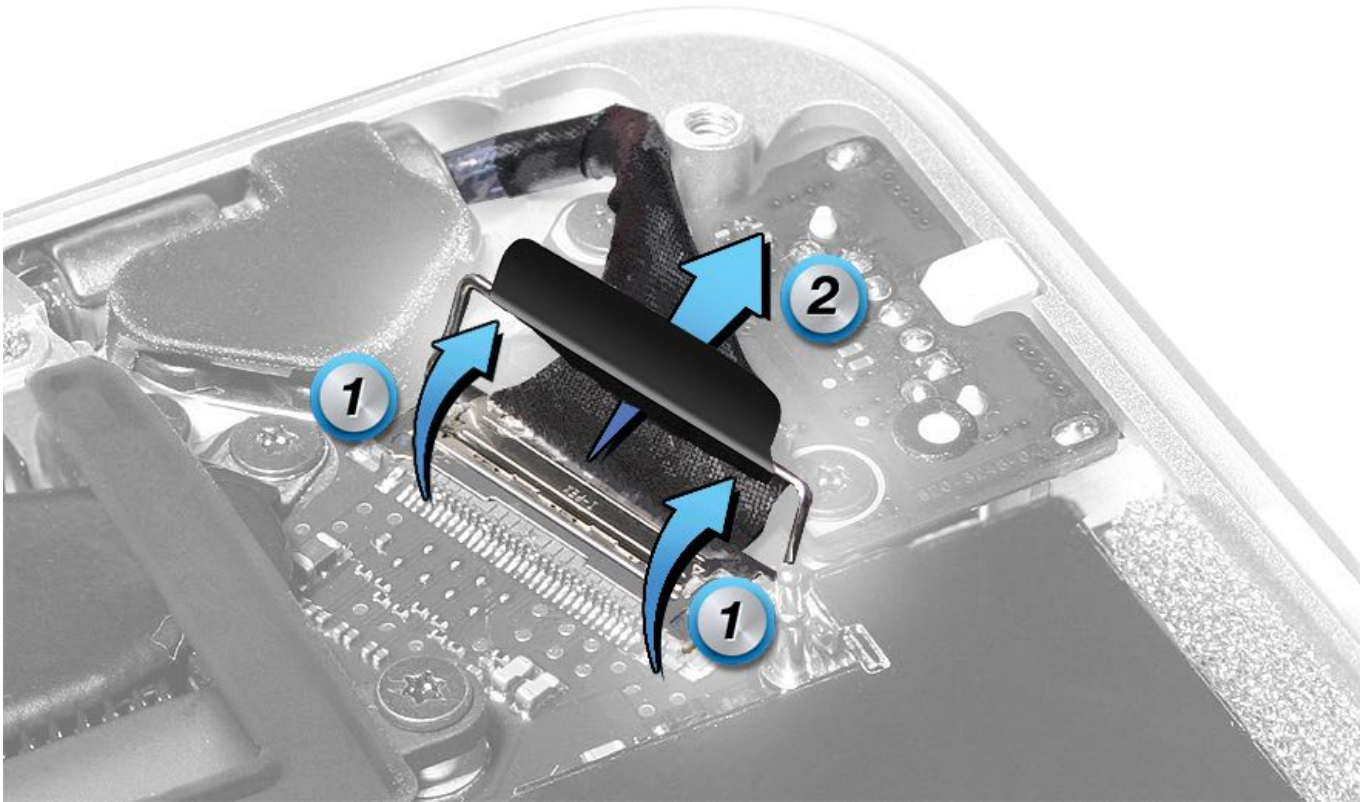
#### **Thin, Multi-Pin Horizontal Insert: Locking Bar**

- Flip up lock bar before disconnecting cable, but do not use bar as a handle when disconnecting.
- Use two black sticks with even force at sides of connector to disconnect it. A gentle rocking motion may be required.
- Align connector with receptacle, and use black sticks to slide the connector into place.
- With cable installed, press lock bar closed until it rests flat on logic board.

Example:

- embedded DisplayPort (eDP) cable

[Thin, Multi-Pin Horizontal Insert Video](#)



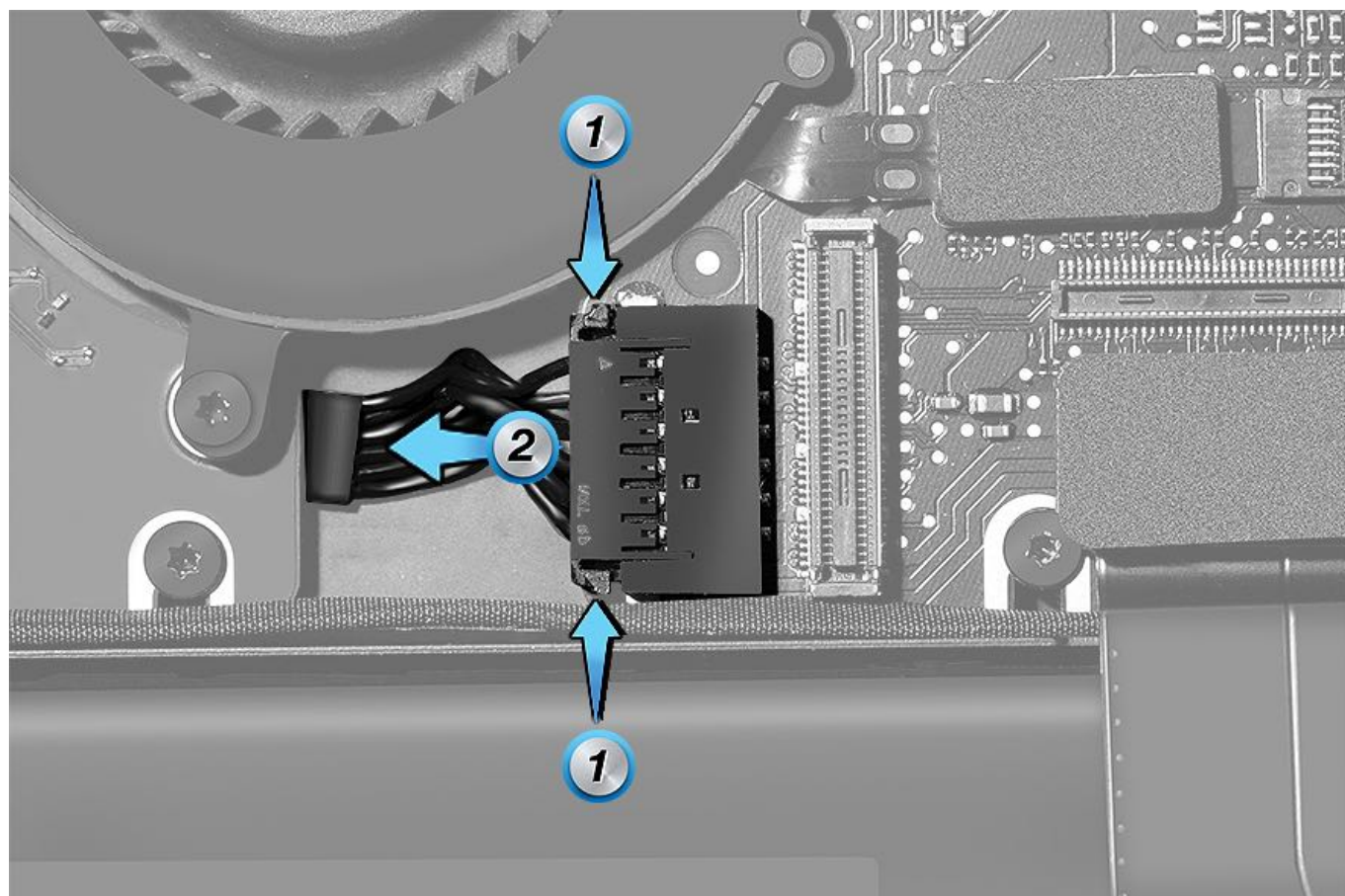
#### Horizontal Install

- Pull connector, not cable, to remove.
- Keep cable parallel to logic board when sliding connector out of or into receptacle.

Example:

- I/O cable to logic board
- MagSafe

[Horizontal Install Video](#)



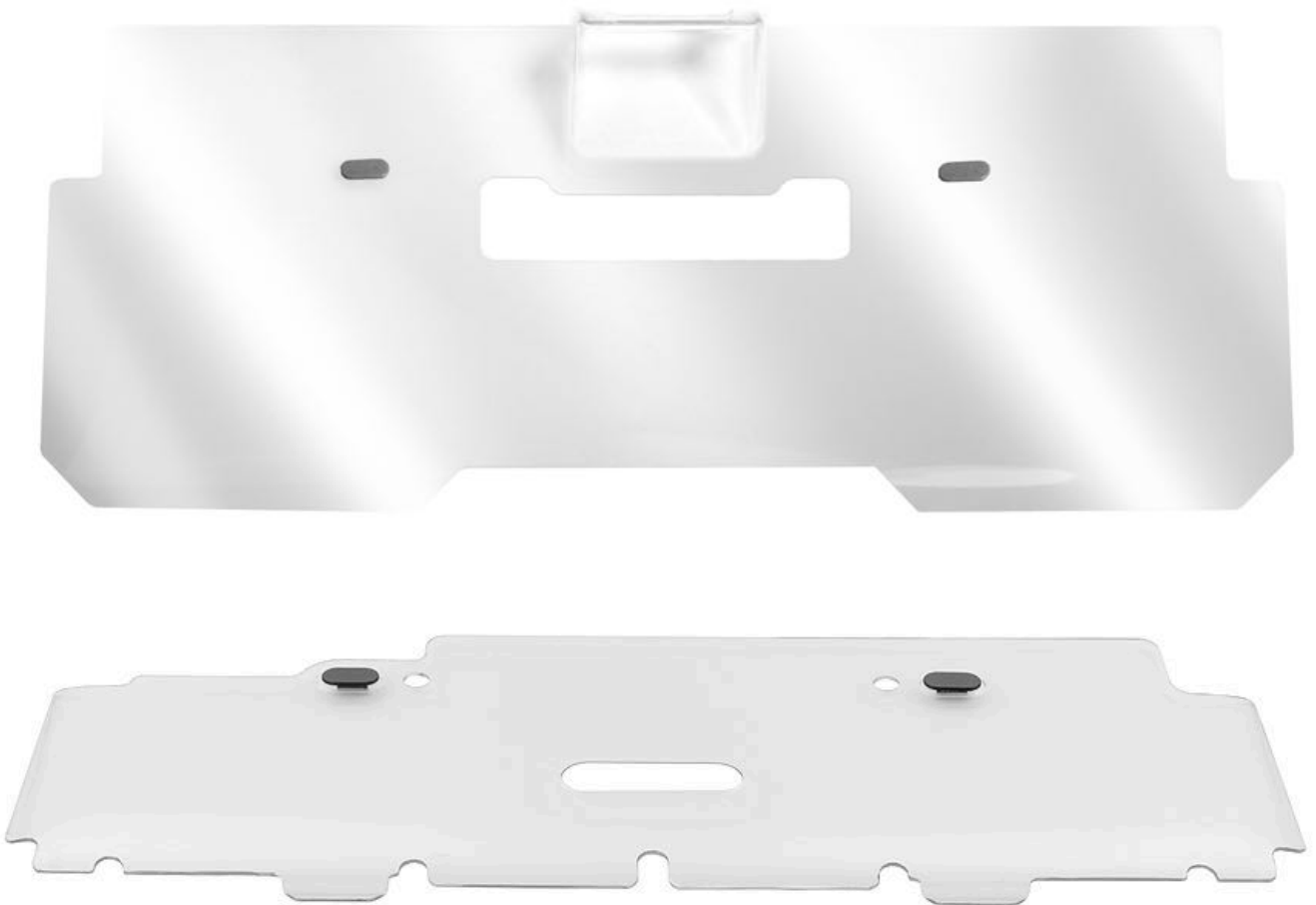
# Tools

## Tools for MacBook Pro (Retina, 13-inch, Late 2012, Early 2013, Late 2013, Mid 2014, Early 2015)

**Caution:** To prevent scratches or other cosmetic damage to the computer housing, use a soft cloth as a protective layer when removing and installing the external screws.

The following tools are required to service the computer:

- Clean, soft, lint-free cloth
- ESD-safe workstation, including an ESD mat and wrist or heel strap
- ESD bags (for storing ESD-sensitive parts while removed from unit)
- ESD-safe nonconductive interposer tweezers (included in kit 076-1411, and shown below) for handling interposer in Late 2012 and Early 2013 models
- ESD-safe tweezers for wireless card cables
- Pentalobe screwdriver (923-0731)
- Torx T5 screwdriver, magnetized
- Torx T6 screwdriver, magnetized
- Torx T8 screwdriver, magnetized
- Phillips #00 screwdriver, magnetized, for trackpad screws and one (1) heat sink screw
- Black stick (nylon probe, 922-5065) or other nonconductive nylon or plastic flat-blade tool
- Thermal grease syringe (included with heat sink and logic board)
- Alcohol wipe (included with heat sink and logic board)
- Magnifying glass, for reading serial number etched on bottom case
- Trackpad calibration weights (923-00462) for the Trackpad Calibration Check, which is performed after every repair on the MacBook Pro (Retina, 13-inch, Early 2015)
- Protective battery cover (kit 076-1411 or cover only: 923-0230 for Late 2012 and Early 2013 models and 923-0705 for Late 2013, Mid 2014, and Early 2015 models)



- Nonconductive Interposer Tweezers



### **Electrostatic Discharge (ESD) Precautions**

Proper ESD precautions must always be used when servicing this product. Make sure you are working on a properly grounded ESD-safe mat and are wearing a properly connected ESD-safe wrist strap.

For more information about ESD, refer to:

- [OP100: Electrostatic Discharge Precautions and Myths](#)
- [ATLAS: ESD Precautions](#)



# First Steps Overview

## First Steps Overview

The following chart shows the parts that must be removed before a take-apart procedure can be performed on a MacBook Pro (Retina, 13-inch, Late 2013, Mid 2014, or Early 2015). Procedures are listed in the left column; parts that must first be removed are indicated with one or more black squares in the row for each procedure.

	Bottom Case	Battery - cover and disconnect	Left Speaker	I/O Flex Cable	Right Speaker	Wireless Card	Flash Storage	MagSafe 2 Board	Heat Sink	Fan	I/O Board	Logic Board	Display with End Caps
<b>PARTS</b>													
Bottom Case	■												
Battery - cover and disconnect*	■	□											
Left Speaker**	■	□	■										
I/O Flex Cable	■	□		■									
Right Speaker**	■	□		■	■								
Wireless Card	■	□				■							
Flash Storage	■	□					■						
MagSafe 2 Board	■	□						■					
Heat Sink	■	□							■				
Fan	■	□		■					■	■			
I/O Board***	■	□		■		■			■	■	■		
Logic Board****	■	□		■			■	■	■	■		■	
Display with End Caps	■	□											■
Top Case with Battery*****	■	□	■	■	■			■	■	■	■	■	■

■ = remove part

□ = attach battery cover and disconnect

## Notes

\* Attach protective battery cover and disconnect battery connector.

\*\* Left and right speakers are paired; if you are replacing one speaker with a new speaker, you must replace both speakers.

\*\*\* If you are replacing an I/O board with a new I/O board, transfer the wireless card to the new I/O board.

\*\*\*\* If you are replacing a logic board with a new logic board, transfer the flash storage to the new logic board.

\*\*\*\*\* Top case with battery includes: battery, keyboard, microphone, and trackpad. **Note:** On the MacBook Pro (Retina, 13-inch, Early 2015) the trackpad flex cable is included with the top case with battery.





# Take Apart Procedure Notes

## Reassembly Steps

When no replacement steps are listed, replace parts in exact reverse order of Removal procedure.

## Note About Images in This Guide

In some cases a pre-production model may have been used to document the procedures in this guide. Although there may be small differences in appearance between the image pictured and the computer you are servicing, the procedures are the same unless noted.

## Screw Sizes

All screw sizes shown are approximate and represent the total length of the screw.



# Bottom Case

## First Steps

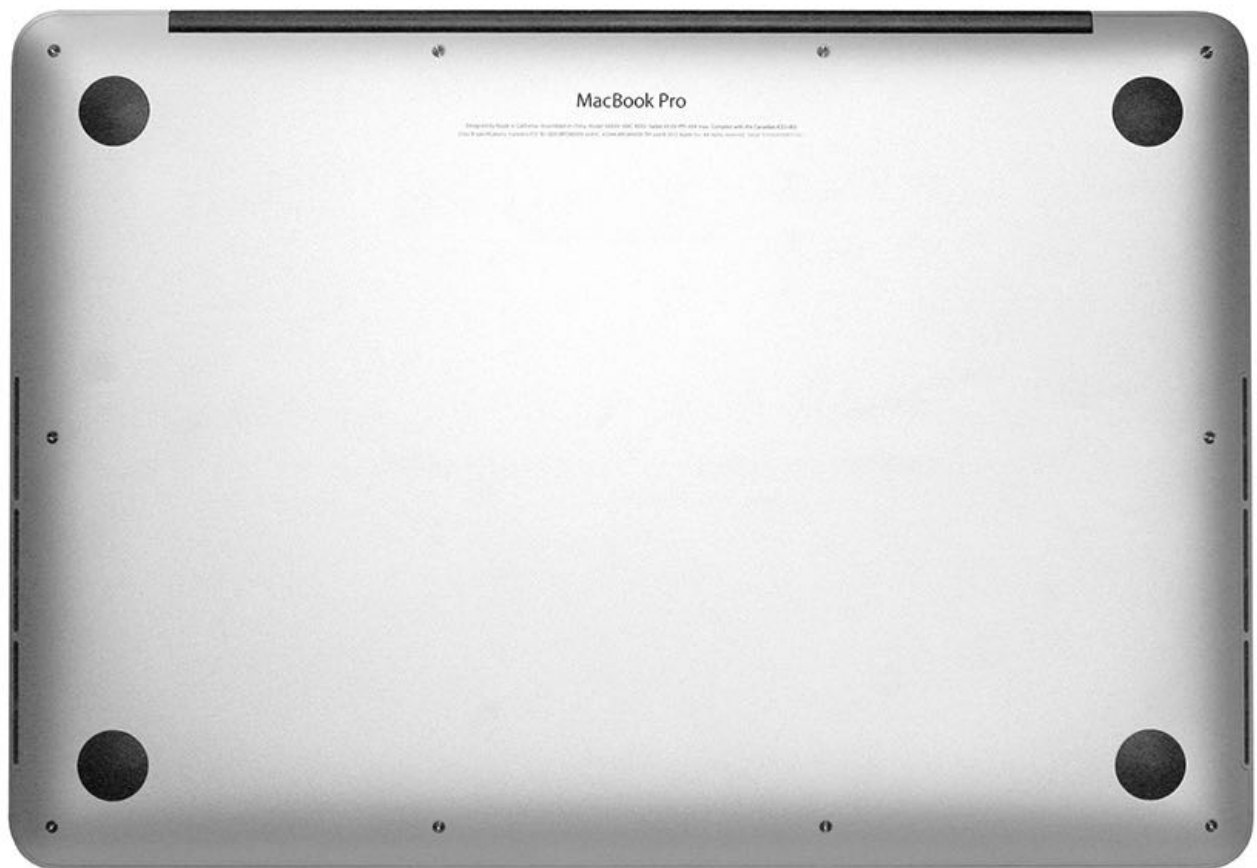
**Important:** This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT202594: Exams for Service Technicians](#).

Before you begin:

- Shut down the computer.
- Unplug all cables.
- Put on an ESD wrist strap.
- Place the computer on a clean, flat surface.

**Important:**

- Always wear an ESD wrist strap and take precautions to avoid ESD.
- Always [attach the battery cover and disconnect the battery](#) immediately after removing the bottom case.



## Tools

- ESD wrist strap
- Clean, soft, lint-free cloth
- Pentalobe screwdriver
- Magnifying glass, optional
- Black stick, optional
- Battery cover



## Steps For Removal

**Caution:** To prevent scratches, use a protective cloth when working with metal tools.

**Important:** Screws must be removed and installed at an angle.



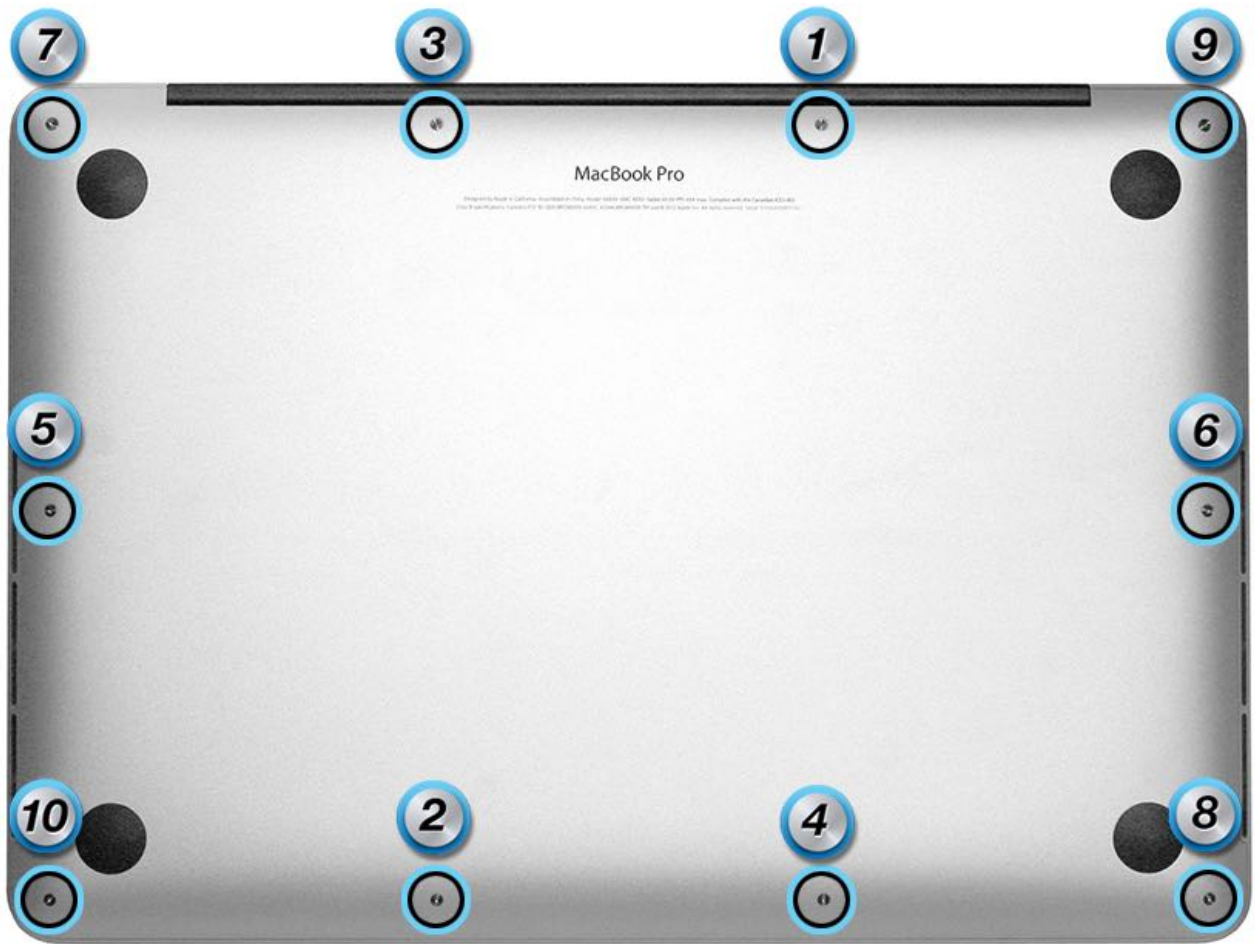
1. Remove ten Pentalobe screws in the order shown.

Eight (3.14 mm) 923-0645 shoulder screws



Two (2.32 mm) 923-0132 shorter screws (#1 and #3 in image)





2. From the top edge, pull the bottom case toward you.



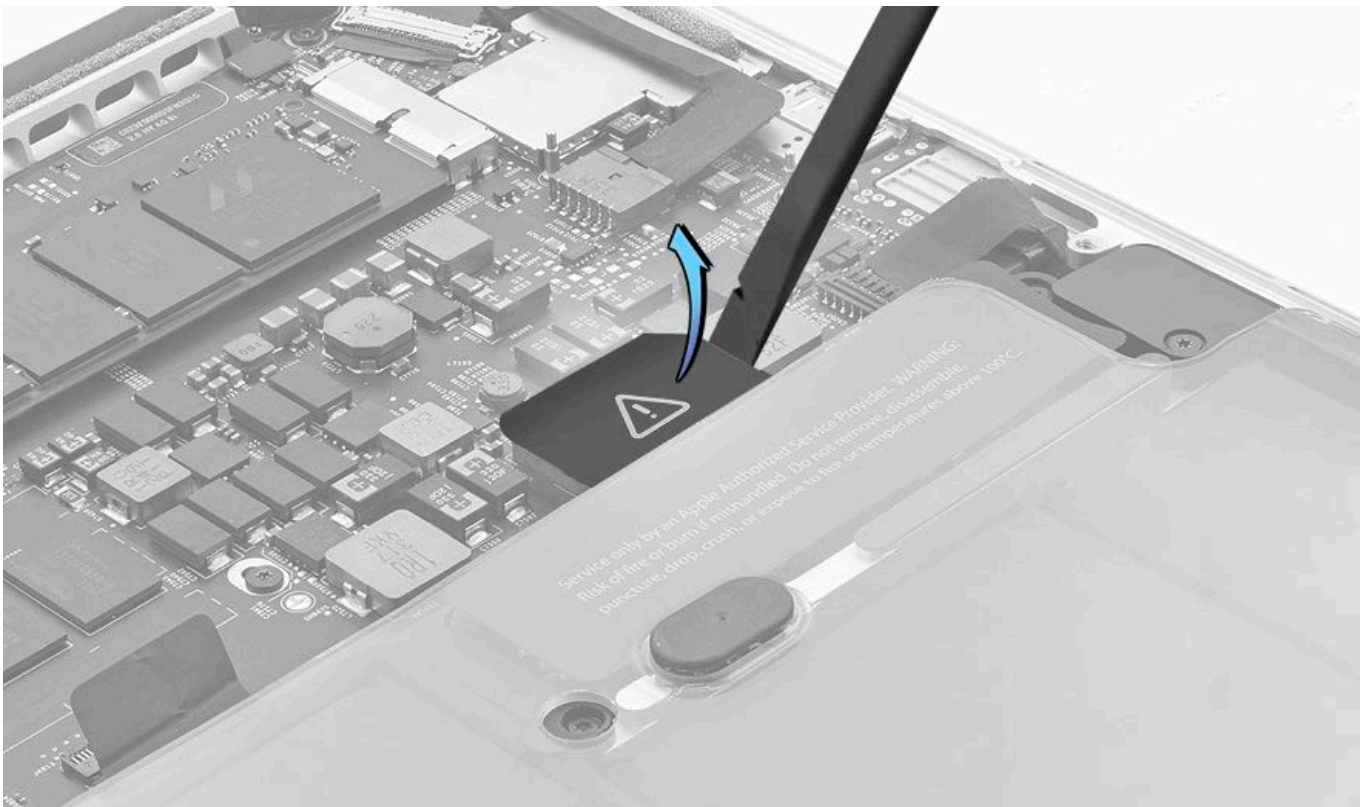
**Note:** If you are replacing the bottom case only and doing no other repairs, proceed to the Reassembly steps.

3. **IMPORTANT:** If you are performing other repairs, do the following in order:

- [Attach the battery service cover](#). Tilt the battery cover when installing to make sure the front edge of the battery cover slips underneath the front lip of the top case. Securely attach the two clips on the battery cover to the top case midwall.
- [Disconnect the battery](#).

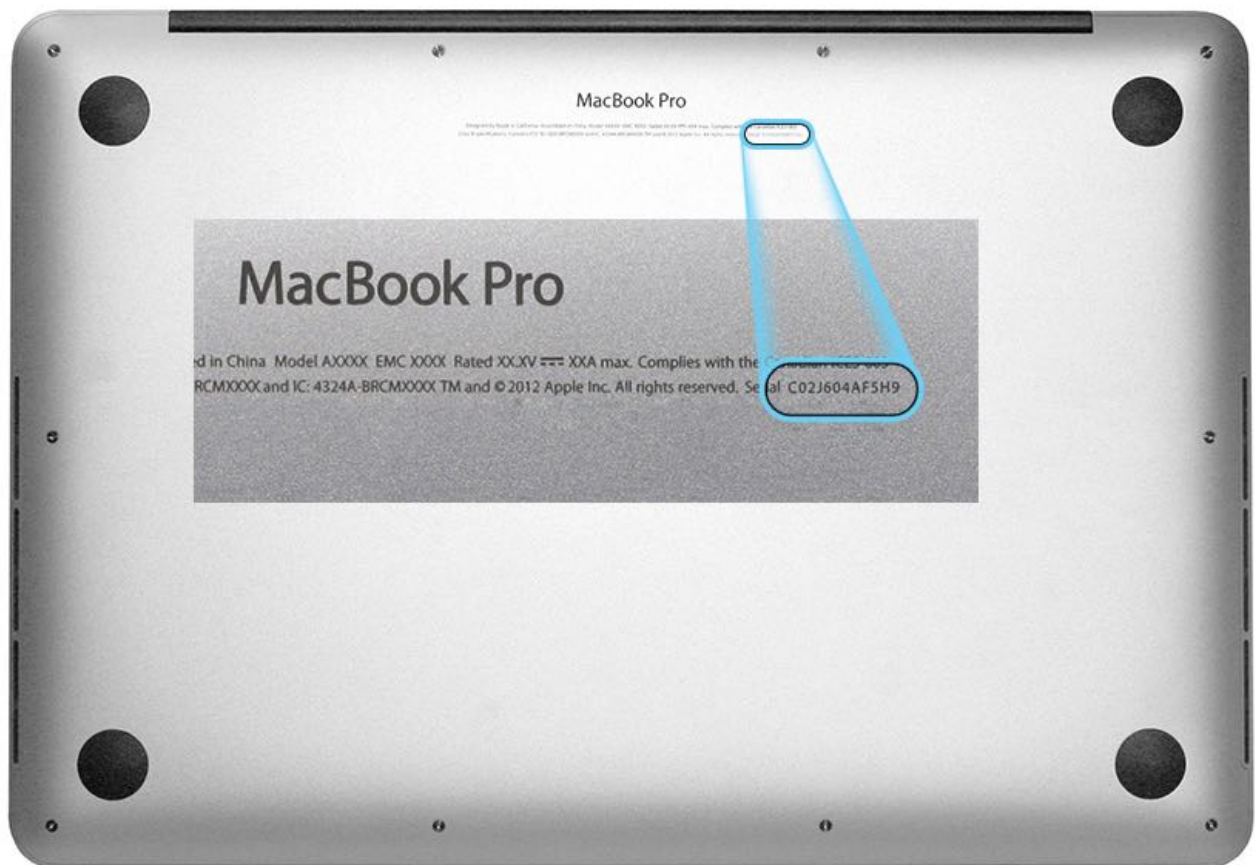






## Steps For Reassembly

1. When installing a new bottom case, retain the original bottom case until the repair is complete. Before installing the replacement bottom case, write the system serial number on the inside of the new bottom case. You might need a magnifying glass to read it. Refer to article [TP1057: Serial Number Locations](#).



Serial number written inside new bottom case



2. Check that the bottom case interior is clean and free of debris.
3. Install the bottom case so that the two clips snap onto the top case.

**MacBook Pro (Retina, 13-inch, Late 2013 and Mid 2014) bottom case**



## MacBook Pro (Retina, 13-inch, Early 2015) bottom case



4. Confirm all screw holes align before installing screws.

**Note:** To prevent offsetting the bottom case, press with two fingers around each screw hole while installing screws.



5. Install screws at an angle and in the order shown.

Eight (3.14 mm) 923-0131 shoulder screws

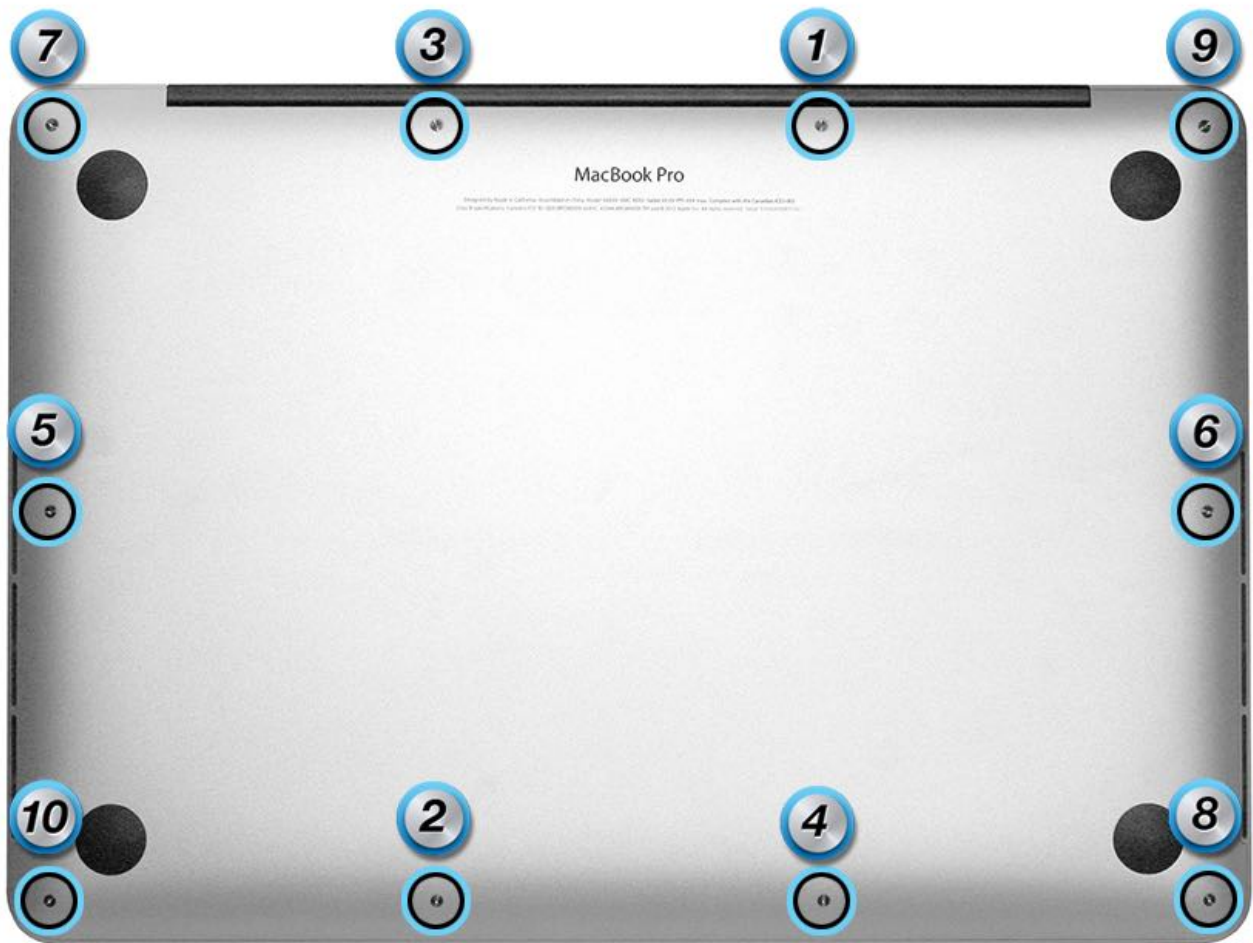




Two (2.32 mm) 923-0132 shorter screws (#1 and #3 in image)



**Reassembly Note:** If screw sequence is not followed, bottom case may wobble when placed on level surface.



**6. MacBook Pro (Retina, 13-inch, Early 2015) only:** Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).

# Battery Cover and Disconnecting the Battery

## First Steps

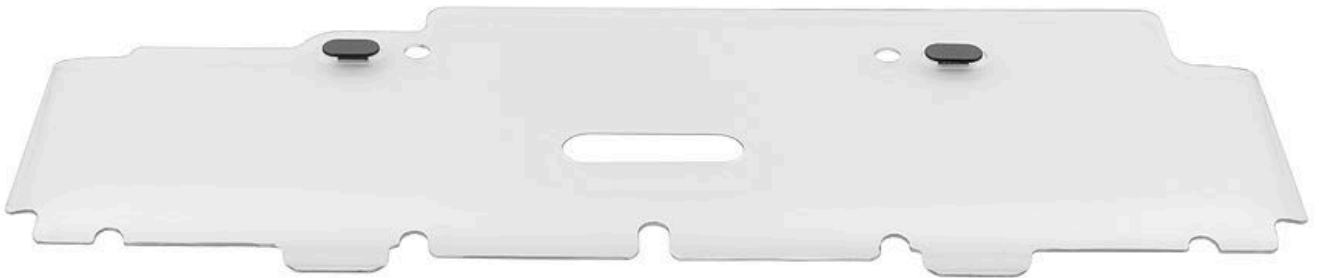
**Important:** This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT202594: Exams for Service Technicians](#).

Remove:

- [Bottom Case](#)

### IMPORTANT:

- Always wear ESD wrist strap and take precautions to avoid ESD.
- Always attach battery cover and disconnect the battery immediately after removing bottom case.



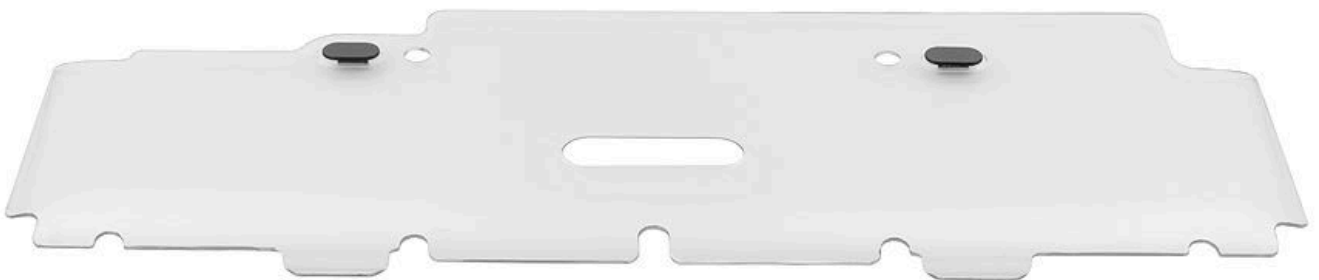
## Tools

- ESD wrist strap
- Black stick
- Battery cover (923-0705)



## Steps For Removal

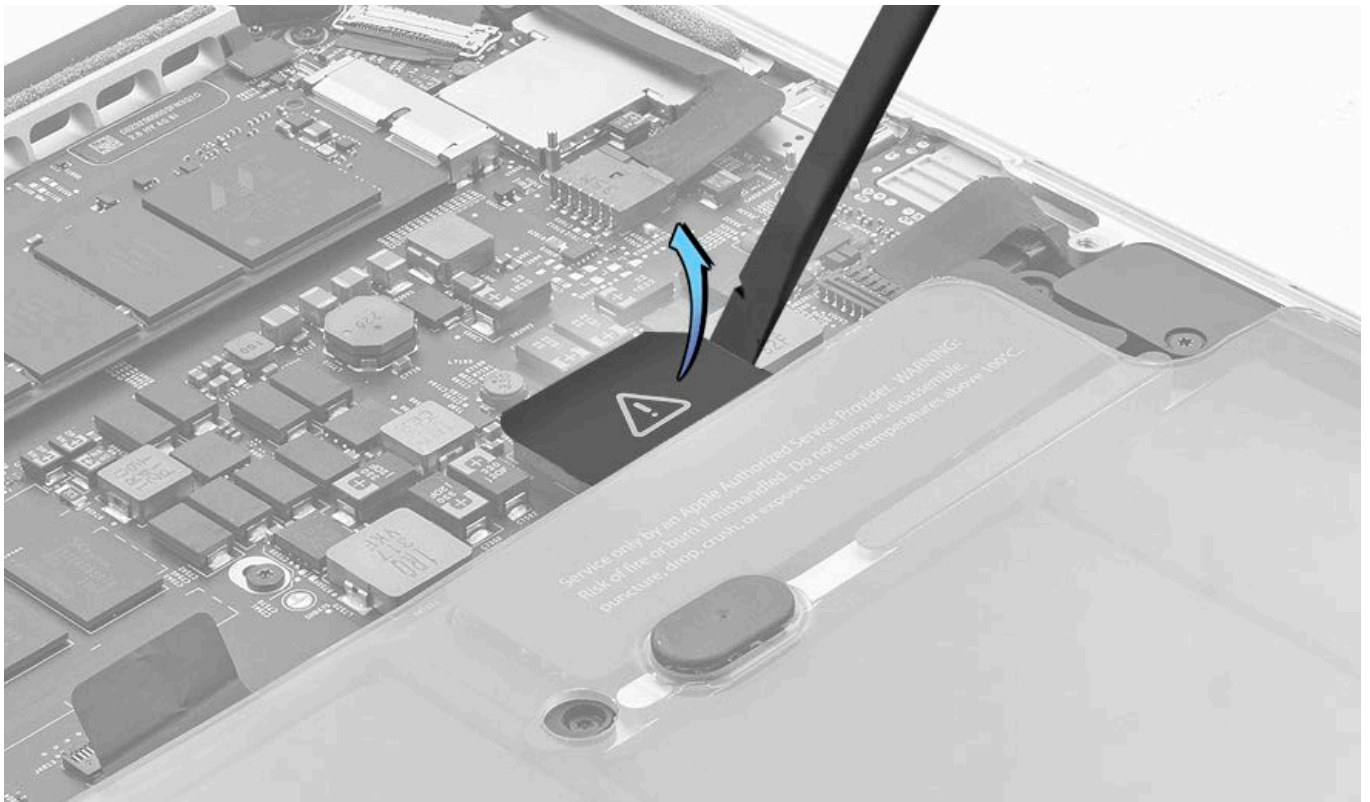
1. Tilt the battery cover to make sure the front edge of the battery cover slips underneath the front lip of the top case.
2. Securely attach the battery cover with two (2) clips that snap onto the midwall of the top case.





3. Use a black stick to disconnect the battery.

**IMPORTANT:** Make sure battery connector is completely disconnected and no longer in contact with the logic board.







## Steps For Reassembly

1. Reassemble in reverse order of removal steps.
2. **MacBook Pro (Retina, 13-inch, Early 2015) only:** Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).

# Input/Output (I/O) Flex Cable

## First Steps

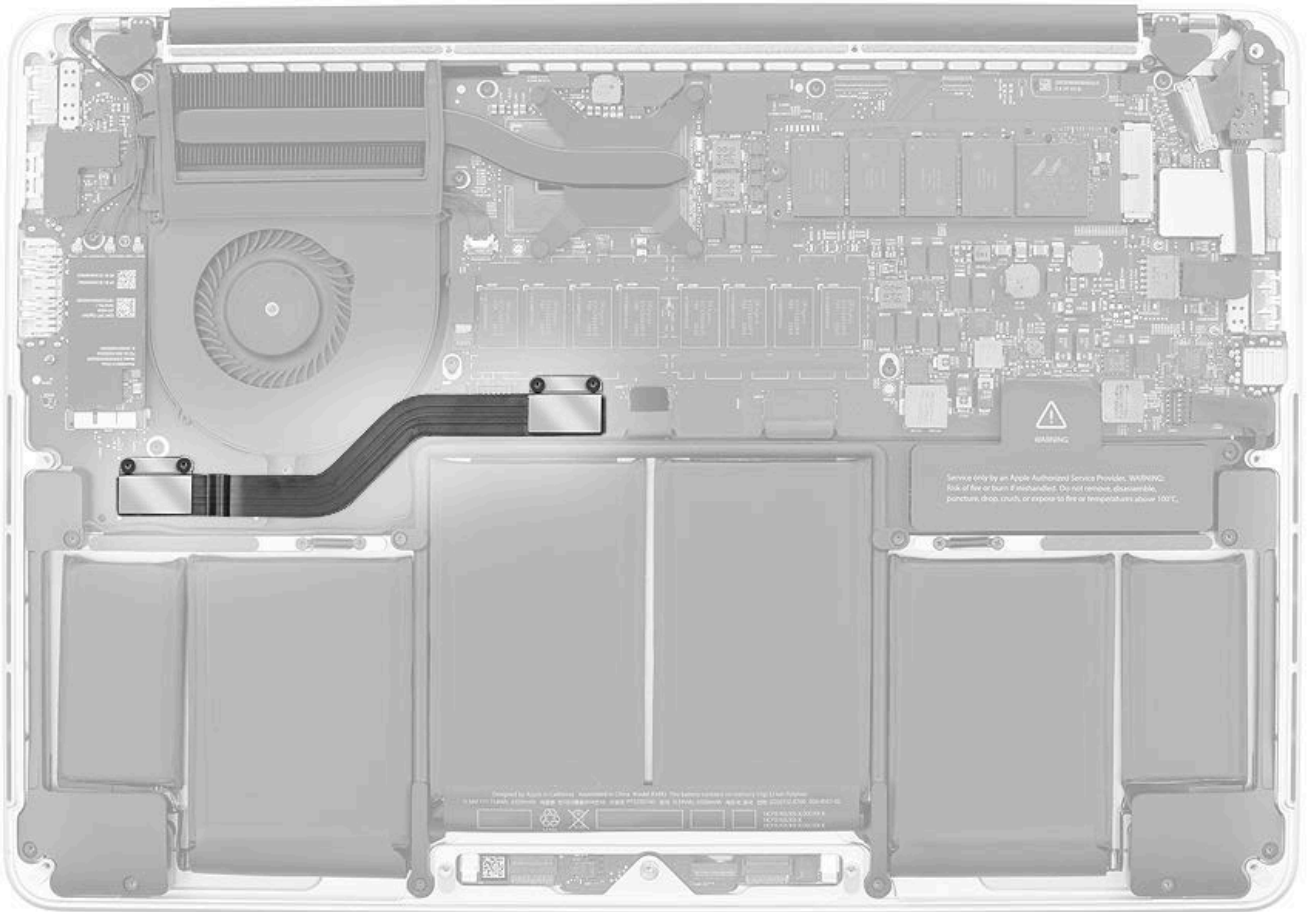
**Important:** This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT202594: Exams for Service Technicians](#).

Remove:

- [Bottom Case](#)

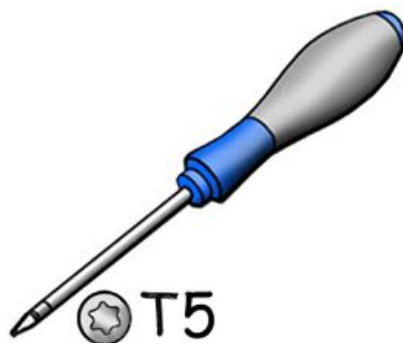
### IMPORTANT:

- Always wear ESD wrist strap and take precautions to avoid ESD.
- Always [attach battery cover and disconnect the battery](#) immediately after removing bottom case.



## Tools

- ESD wrist strap
- Torx T5 screwdriver, magnetized
- Black stick

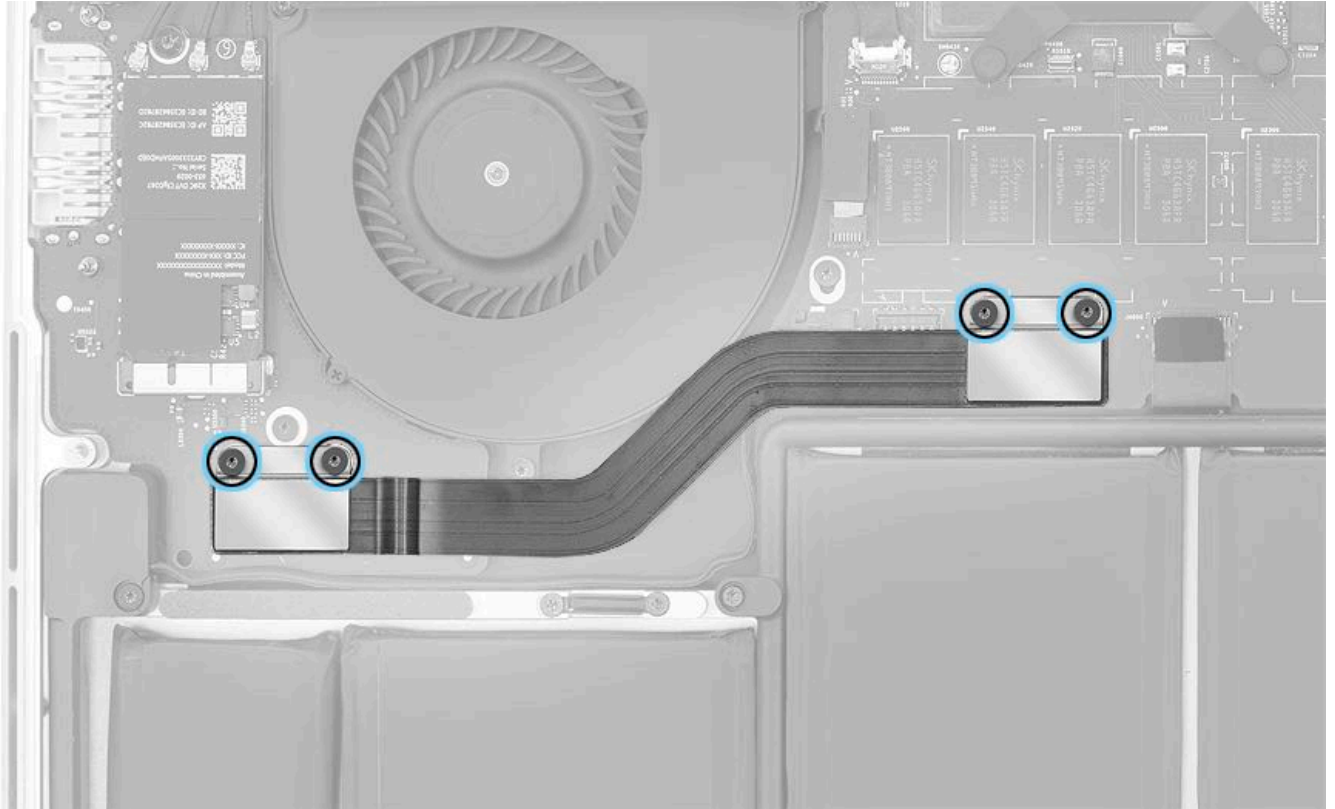


## Steps For Removal

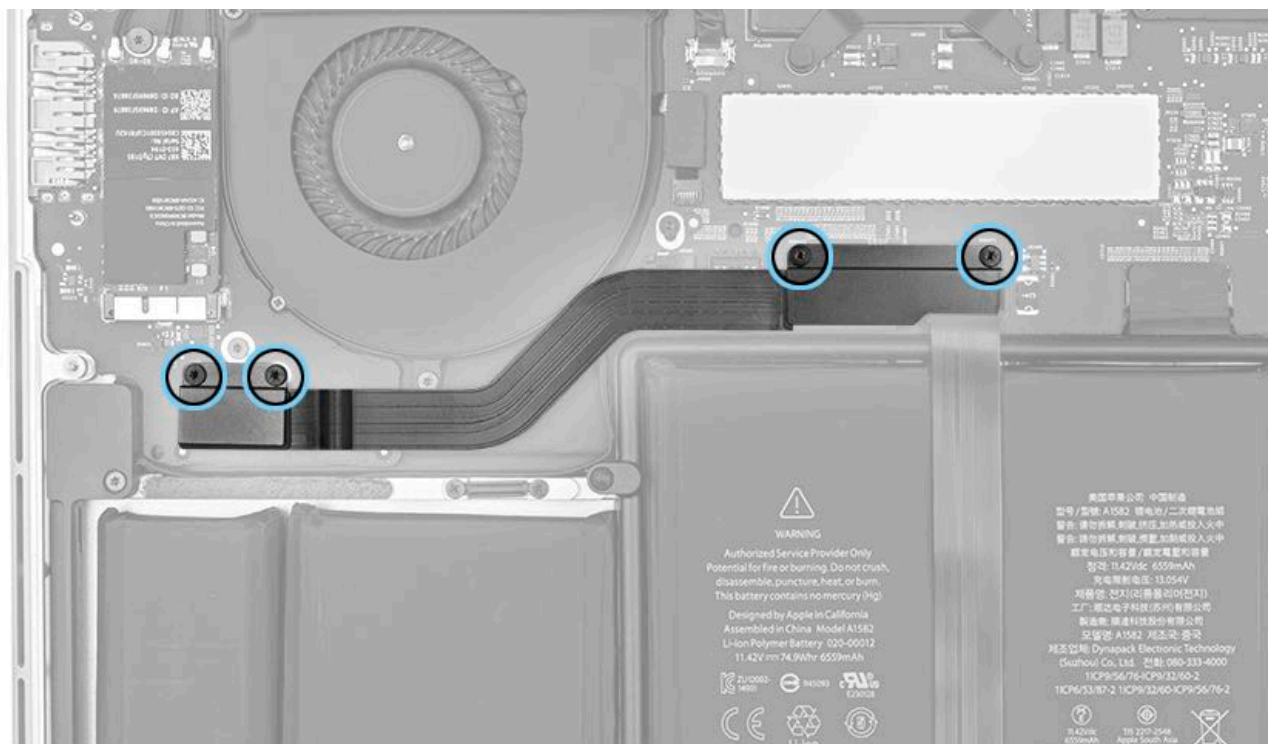
1. Use Torx T5 screwdriver to remove four screws (923-0649) on the metal brackets.



### MacBook Pro (Retina, 13-inch, Late 2013 and Mid 2014) I/O flex cable brackets

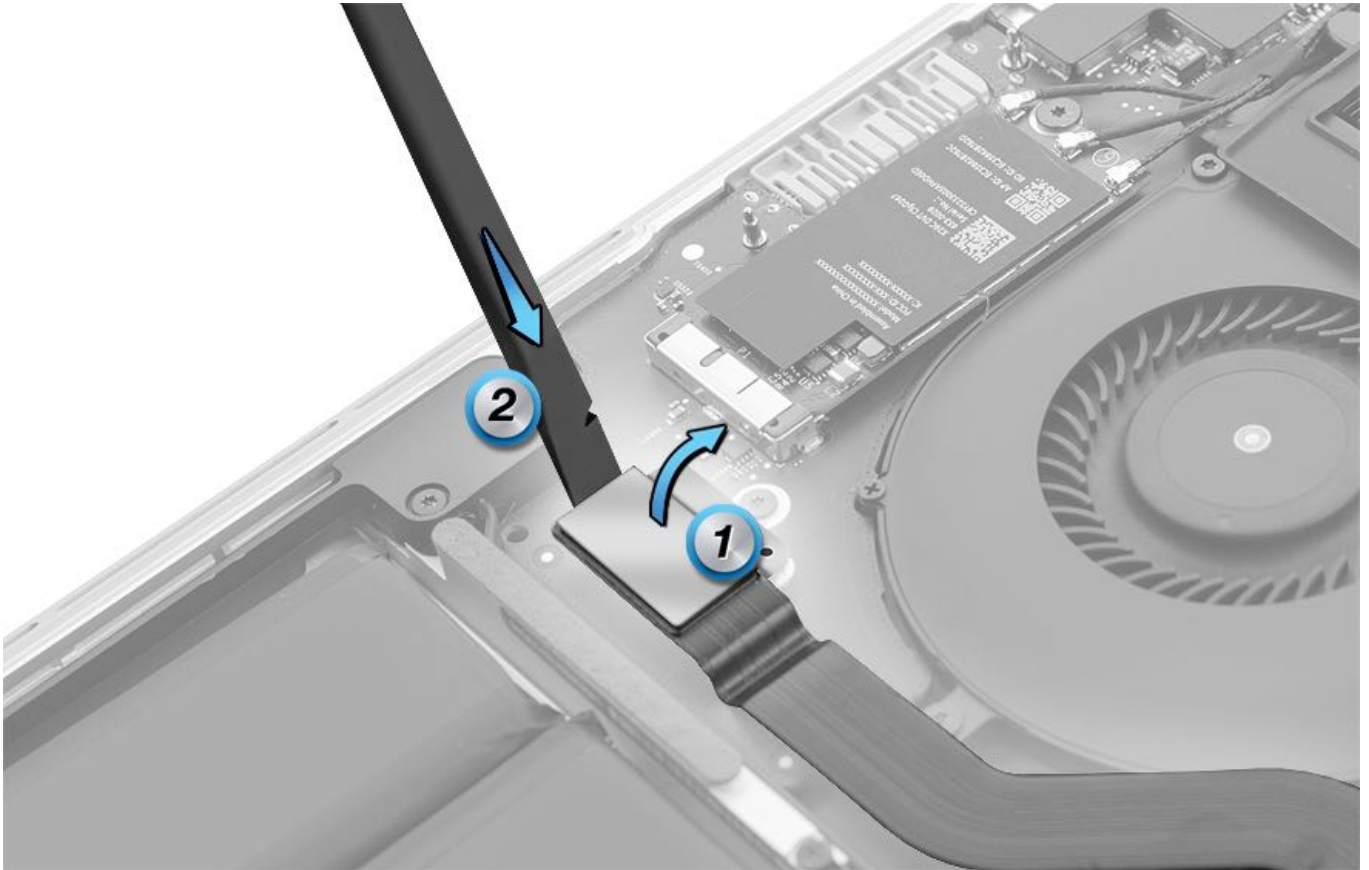


### MacBook Pro (Retina, 13-inch, Early 2015) I/O flex cable brackets



2. Remove the metal bracket (1), then use the black stick to pry the I/O flex cable (2) off the logic board connector. Repeat

for the other end of the I/O flex cable.



## Steps For Reassembly

1. Reassemble in reverse order of removal steps.

### IMPORTANT:

- Check for bent pins to the connectors on the boards and to the connectors on the I/O flex cable before attaching the cable.
- Do **NOT** attempt to attach the I/O flex cable if there is any damage to the board or the cable connectors.
- The I/O flex cable can only connect one way. The connectors on the cable are not reversible.
- Align the grooves of the connector to the pins in the corresponding receptacle.
- Keep the connector level while attaching.
- Press firmly on each end of the cable to make sure the connector is securely attached to the boards.

2. **MacBook Pro (Retina, 13-inch, Early 2015) only:** Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).

# Right and Left Speakers

## First Steps

**Important:** This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT202594: Exams for Service Technicians](#).

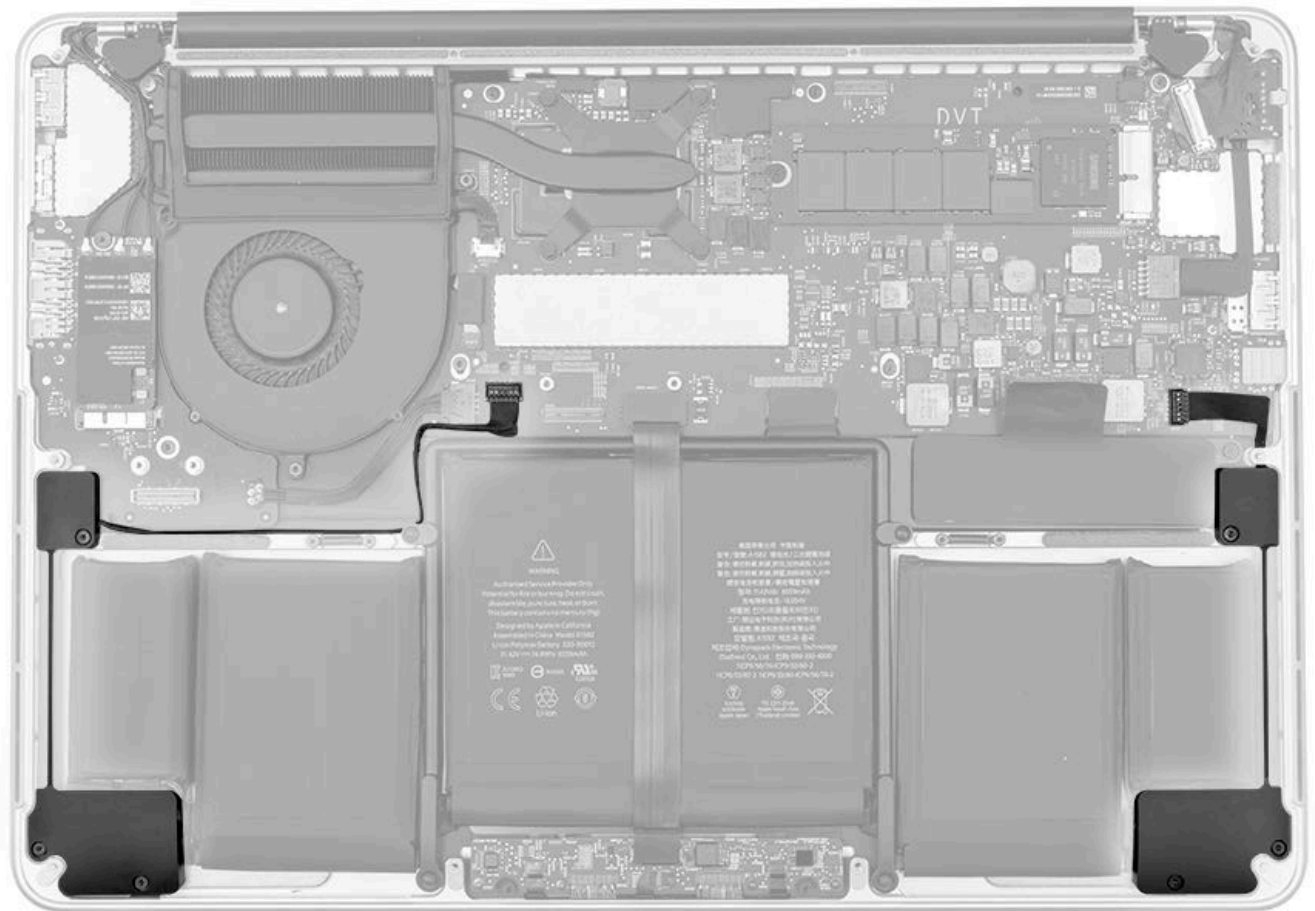
Remove:

- [Bottom Case](#)
- [Input/Output \(I/O\) Flex Cable](#)

## IMPORTANT:

- Always wear an ESD wrist strap and take precautions to avoid ESD.
- Always [attach a battery cover and disconnect the battery](#) immediately after removing the bottom case.

**Note:** The left speaker is located on the right side of the image. The right speaker is located on the left side of the image.



## Tools

- ESD wrist strap
- Torx T5 screwdriver (magnetized)
- Black stick





## Steps For Removal

**IMPORTANT:** The right and left speakers are paired and only offered as a kit. If you need to replace one speaker, you must replace both. Do not save a used, good speaker for another repair; the speakers are fine-tuned to each other by the manufacturer and will not operate properly if mismatched. If installing replacement speakers from the speaker kit, reuse the original two screws at location 1 and 2. Install the replacement screw that comes with the speaker kit in location 3 only.

1. Disconnect the left speaker cable and remove three T5 screws:

**Screw 1:** One medium screw (6.32 mm) 923-0647 at the middle corner



**Screw 2:** One short screw (4.85 mm) 923-0651 at the bottom front



### Screw 3:

**MacBook Pro (Retina, 13-inch, Late 2013 and Mid 2014):** Uses either screw shown below. The speaker kit, part number 923-0557, ships with either the 923-0644 screw or with the shoulder screw (no service part number, available only with the speaker kit).

**MacBook Pro (Retina, 13-inch, Early 2015):** Uses the shoulder screw, which is available only in the speaker kit, part number 923-00509.

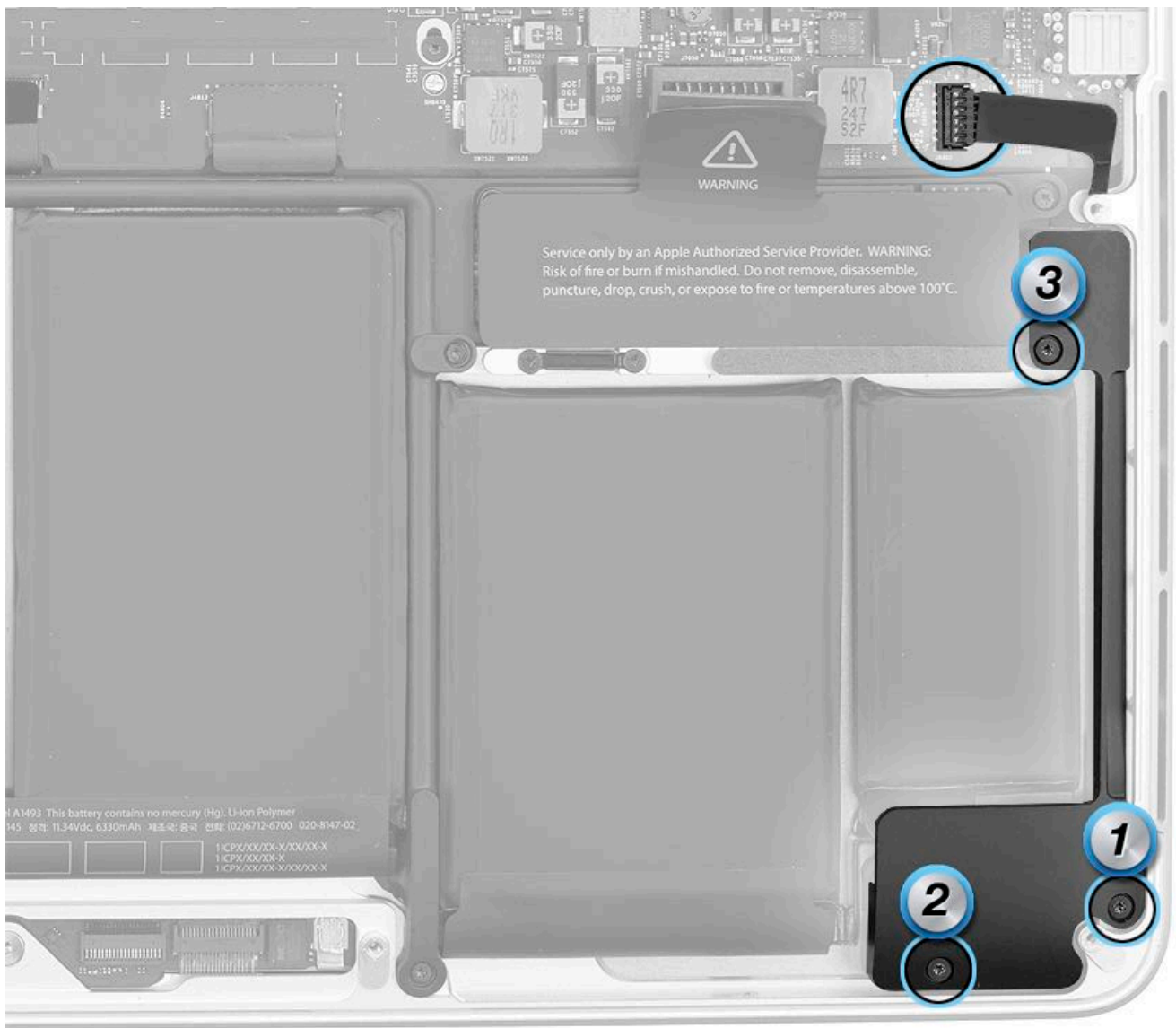
- One long screw (6.75 mm) 923-0644, used on the MacBook Pro (Retina, 13-inch, Late 2013 and Mid 2014)



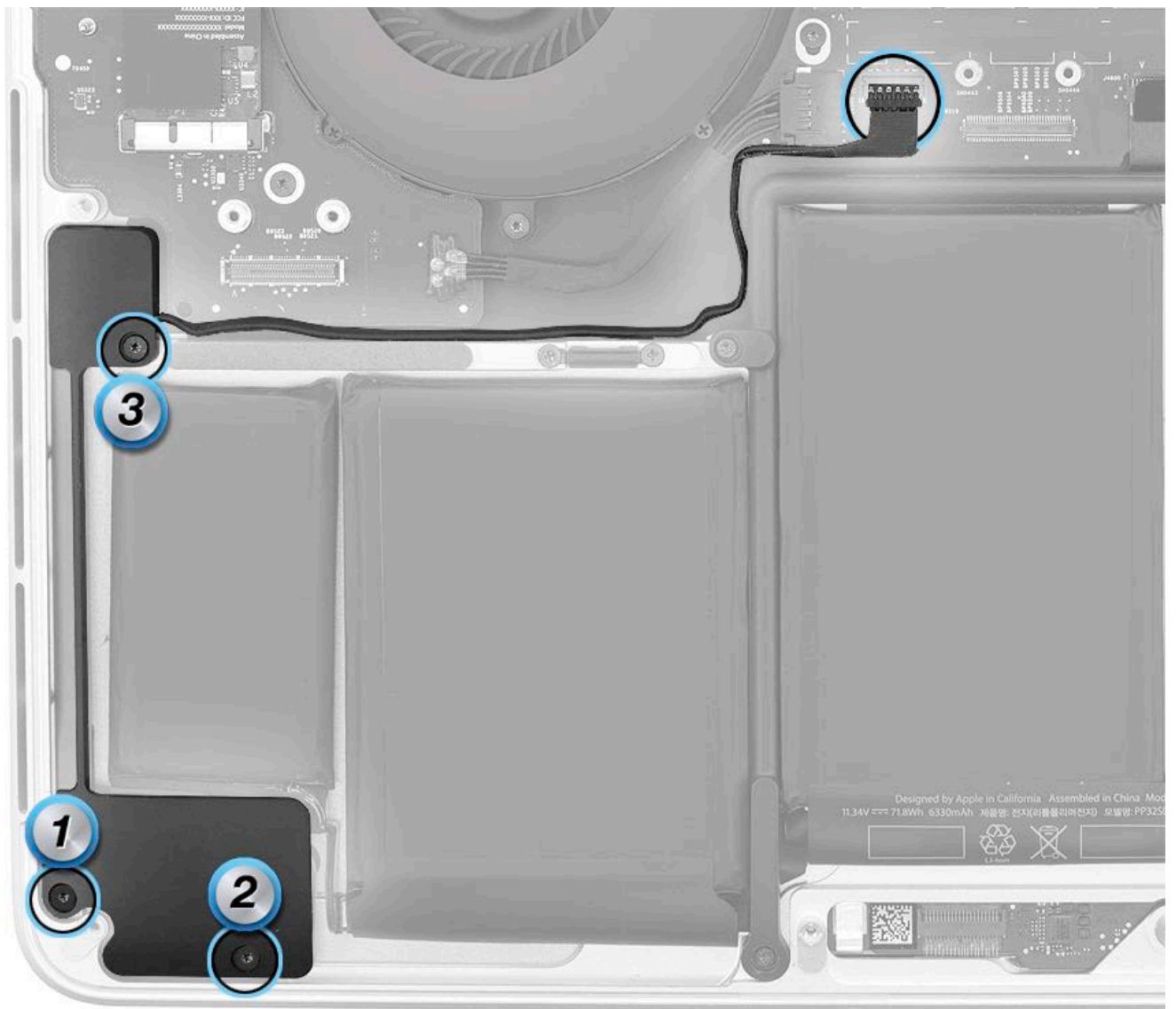
- One shoulder screw (5.61 mm), not available separately







2. For the right speaker, remove the I/O flex cable and disconnect the right speaker cable. Remove three T5 screws. The right speaker screws are identical in size and their locations are numbered the same as the screws for the left speaker.



3. With the battery cover clips still engaged, tilt up the end of the battery cover to remove the speakers one at a time.



### Steps For Reassembly

1. If installing the original speakers, reassemble in reverse order of removal steps. If installing replacement speakers from the speaker kit, reuse the original two screws at the bottom of the speakers. Use the replacement screw that came with the speaker kit in location 3 only.



2. **MacBook Pro (Retina, 13-inch, Early 2015) only:** Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).



# Wireless Card

## First Steps

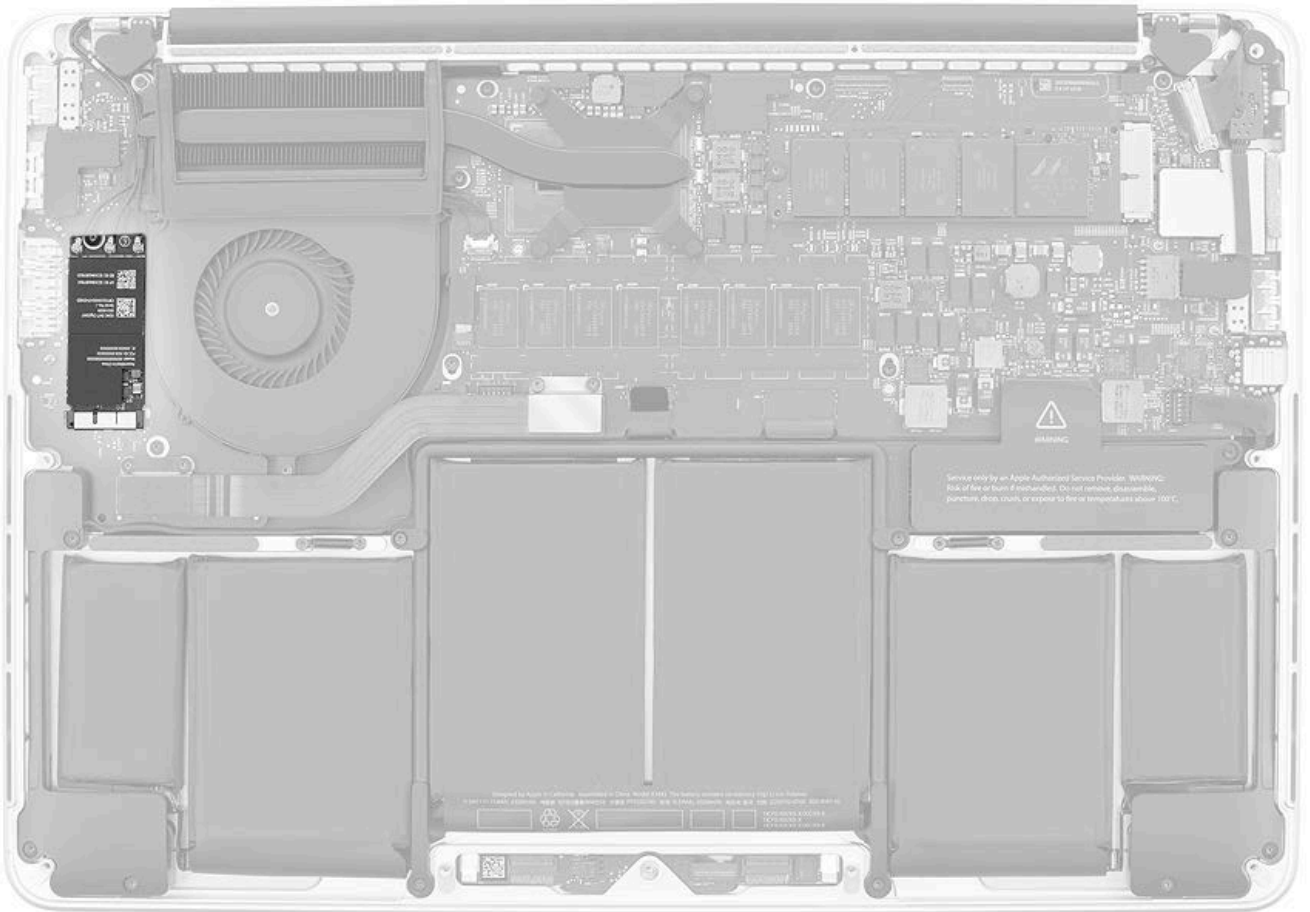
**Important:** This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT202594: Exams for Service Technicians](#).

Remove:

- [Bottom Case](#)

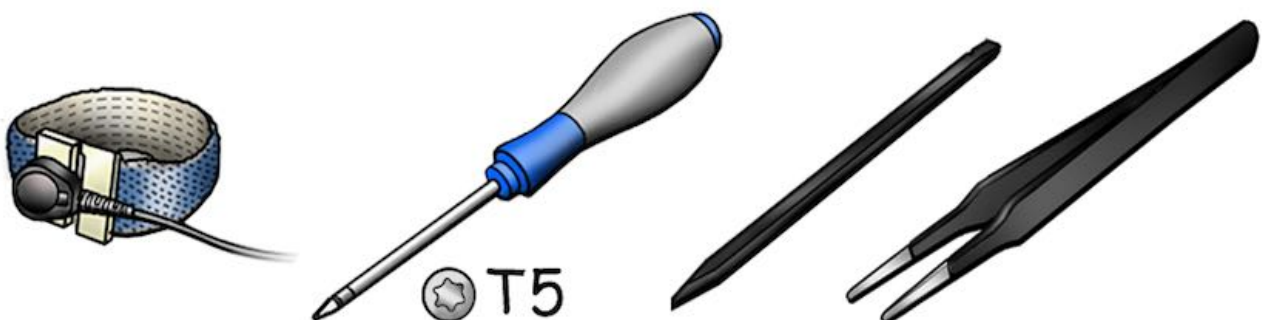
### IMPORTANT:

- Always wear ESD wrist strap and take precautions to avoid ESD.
- Always [attach battery cover and disconnect the battery](#) immediately after removing bottom case.



## Tools

- ESD wrist strap
- Torx T5 screwdriver, magnetized
- Black stick
- ESD-safe tweezers





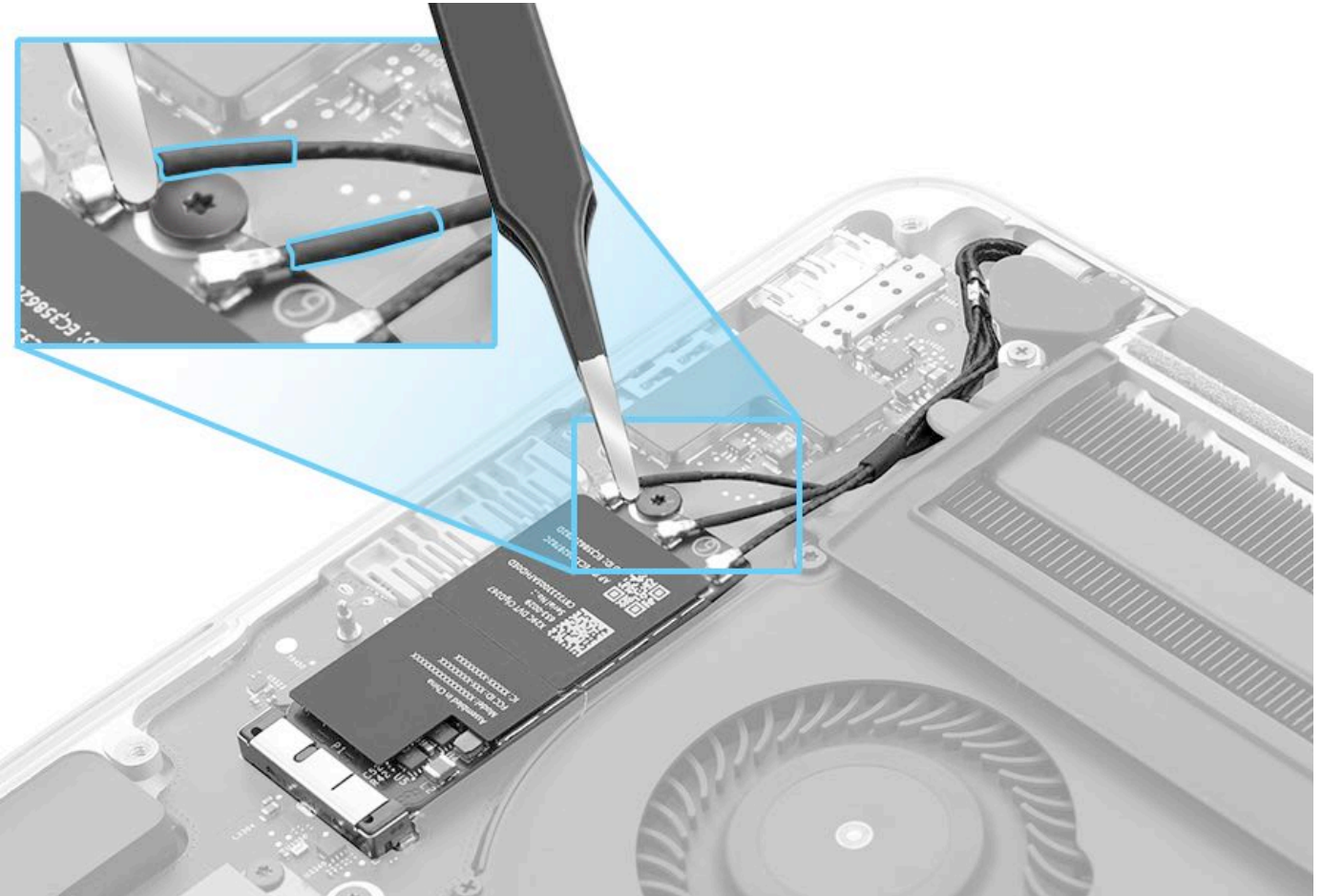
## Steps For Removal

1. Make note of the antenna cable routing and insulation:

- Short insulation: Cable connects closest to HDMI port
- Long insulation: Cable connects to middle connector
- No insulation: Cable connects closest to fan

**Important:** Do not swap cable positions, and make sure cables do not overlap screws.

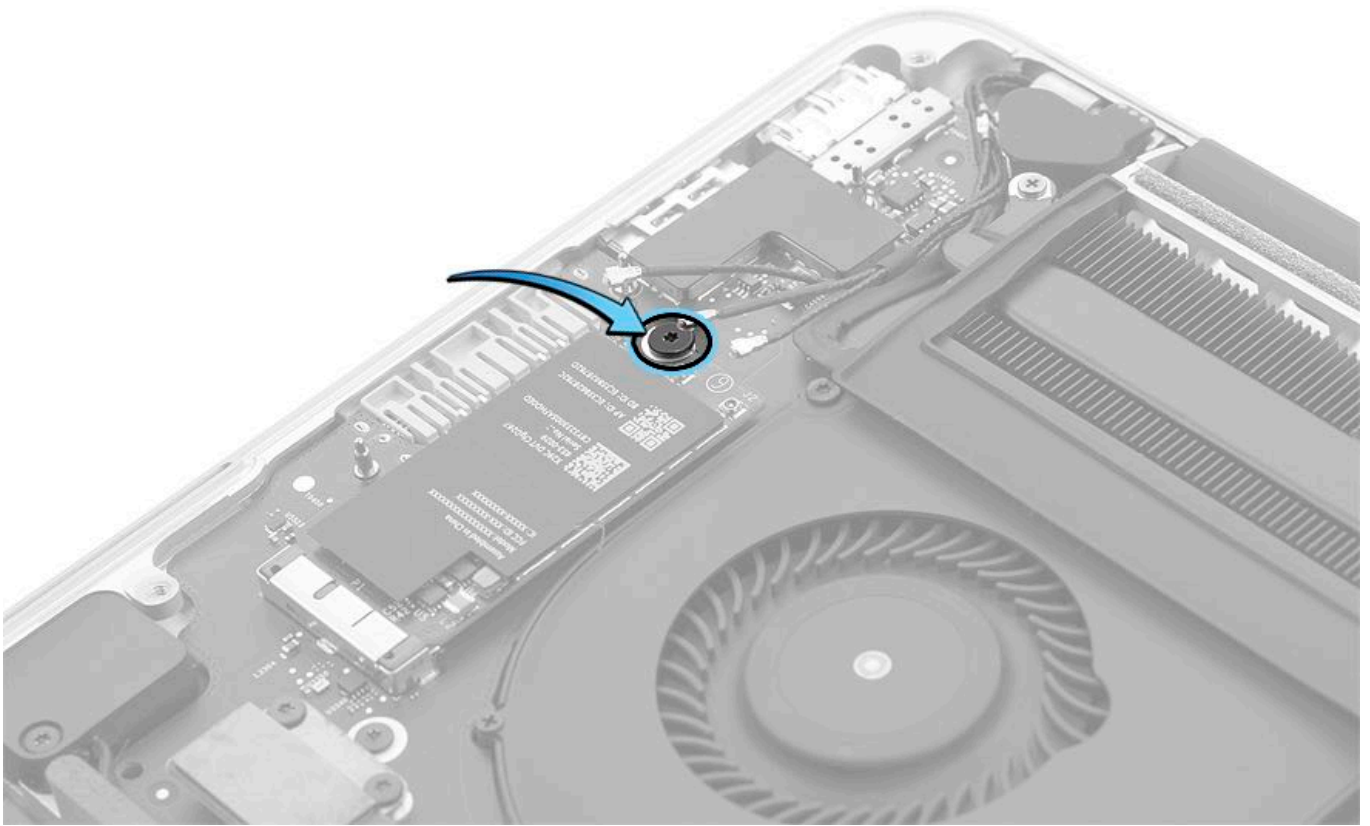
2. Using tweezers, carefully grip first antenna cable on metal extension behind connector head. Gently pop cable straight up off card. Repeat for other two antenna cables.



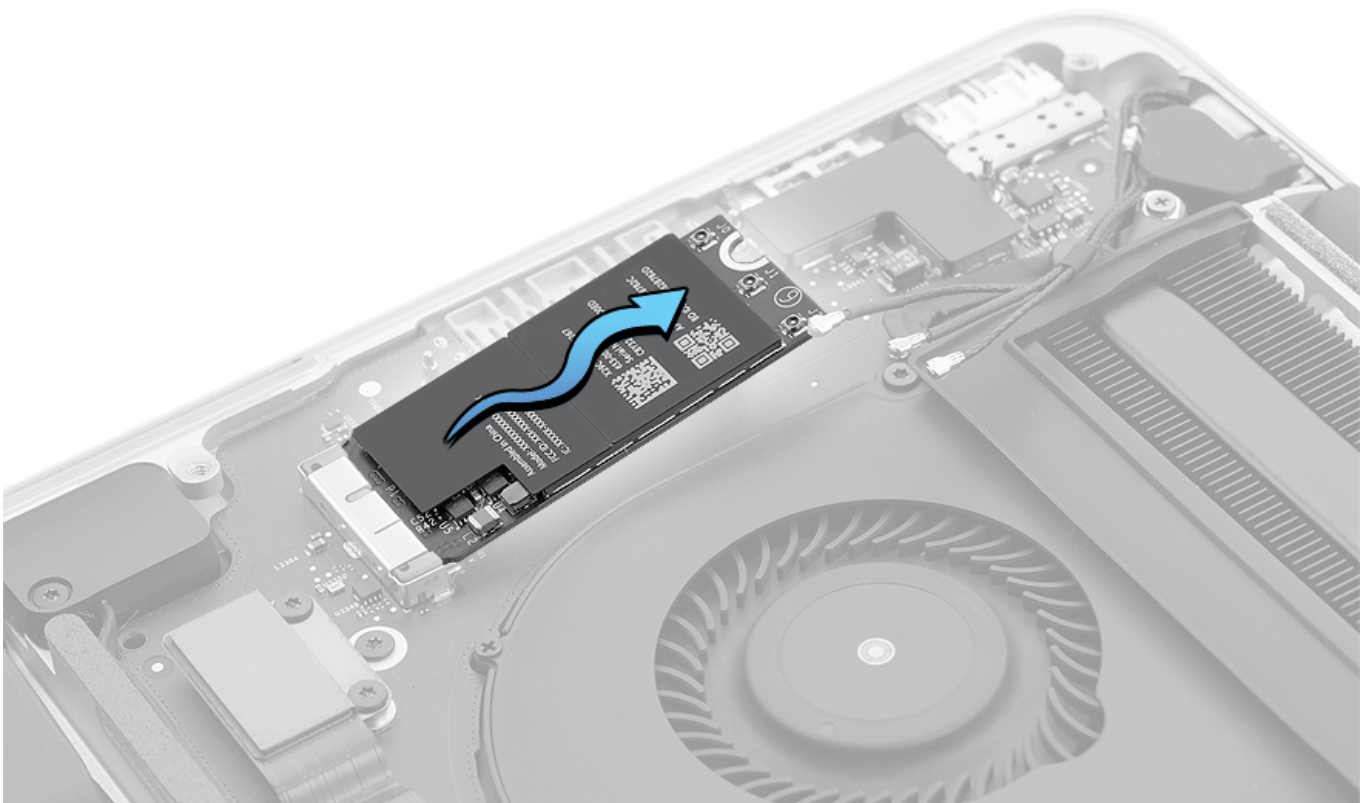
3. Remove one (2.68 mm) 923-0314 Torx T5 screw.





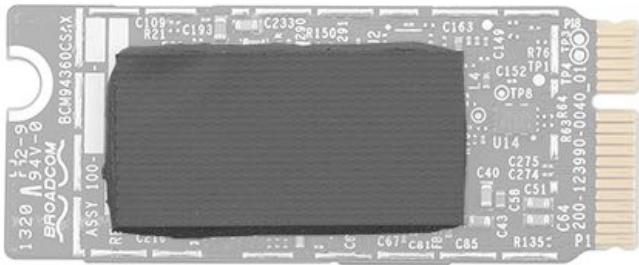


5. Lift up end of card a short distance and then gently rock and pull card to disconnect it from logic board connector.



**Note:** If thermal pad adheres to logic board, carefully peel pad from board. Check board and remove any residue.

If reinstalling this card, check thermal pad and reattach to underside of card, as shown. Or, if pad is damaged, attach new thermal pad. If installing new card, note that replacement cards come with thermal pad adhered.



## Steps For Reassembly

**Note:** If you are reinstalling the existing card, check that thermal pad is properly attached to underside of card.

1. Insert card into logic board connector.
2. Replace one (2.68 mm) 923-0314 screw.

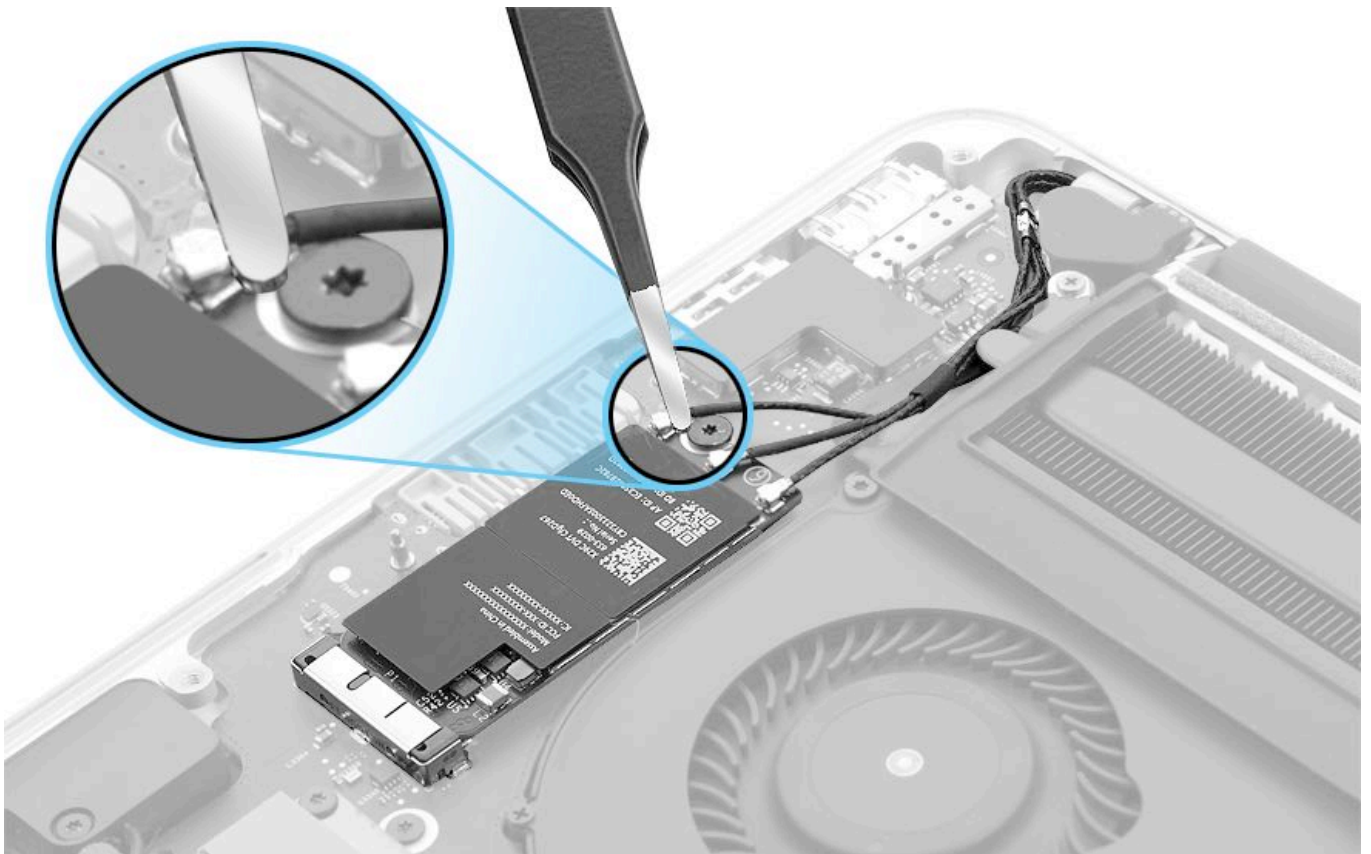


3. Using tweezers, position antenna cable head over connector until you feel it seat with the connector. Then carefully press straight down with a finger until head snaps into place. Repeat for other two antenna cables.

- Short insulation: Cable connects closest to HDMI port
- Long insulation: Cable connects to middle connector
- No insulation: Cable connects closest to fan

**Important:** Do not swap cable positions, and make sure cables do not overlap screws.

**Caution:** Using too much force to reseat antenna cables can distort connector or connector rim.



4. **MacBook Pro (Retina, 13-inch, Early 2015) only:** Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).

# Flash Storage

## First Steps

**Important:** This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT202594: Exams for Service Technicians](#).

For video instruction, refer to article [SV218: Flash Storage Replacement Video](#).

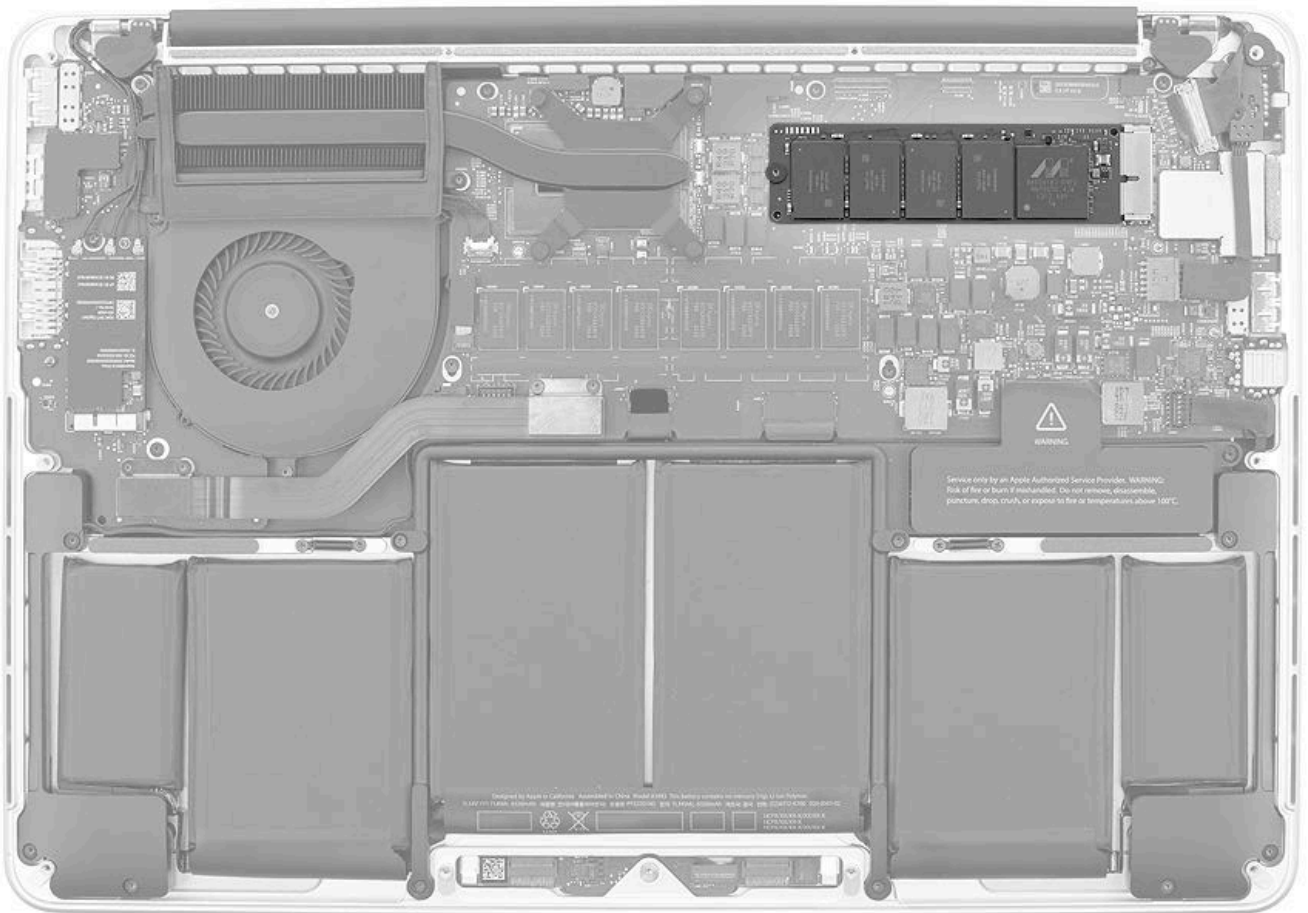
Remove:

- [Bottom Case](#)

### IMPORTANT:

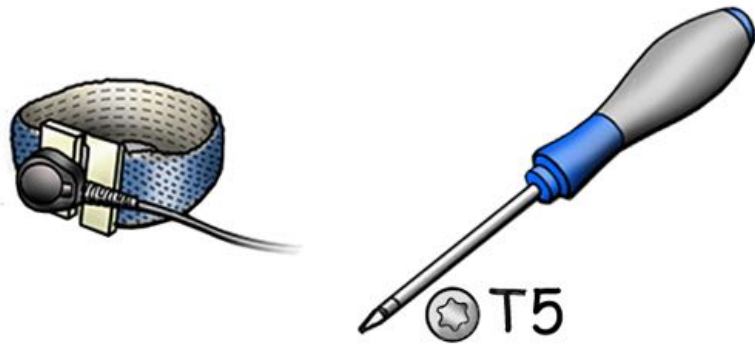
- Always wear ESD wrist strap and take precautions to avoid ESD.
- Always [attach battery cover and disconnect the battery](#) immediately after removing bottom case.

**Caution:** Make sure data is backed up before removing flash storage.



## Tools

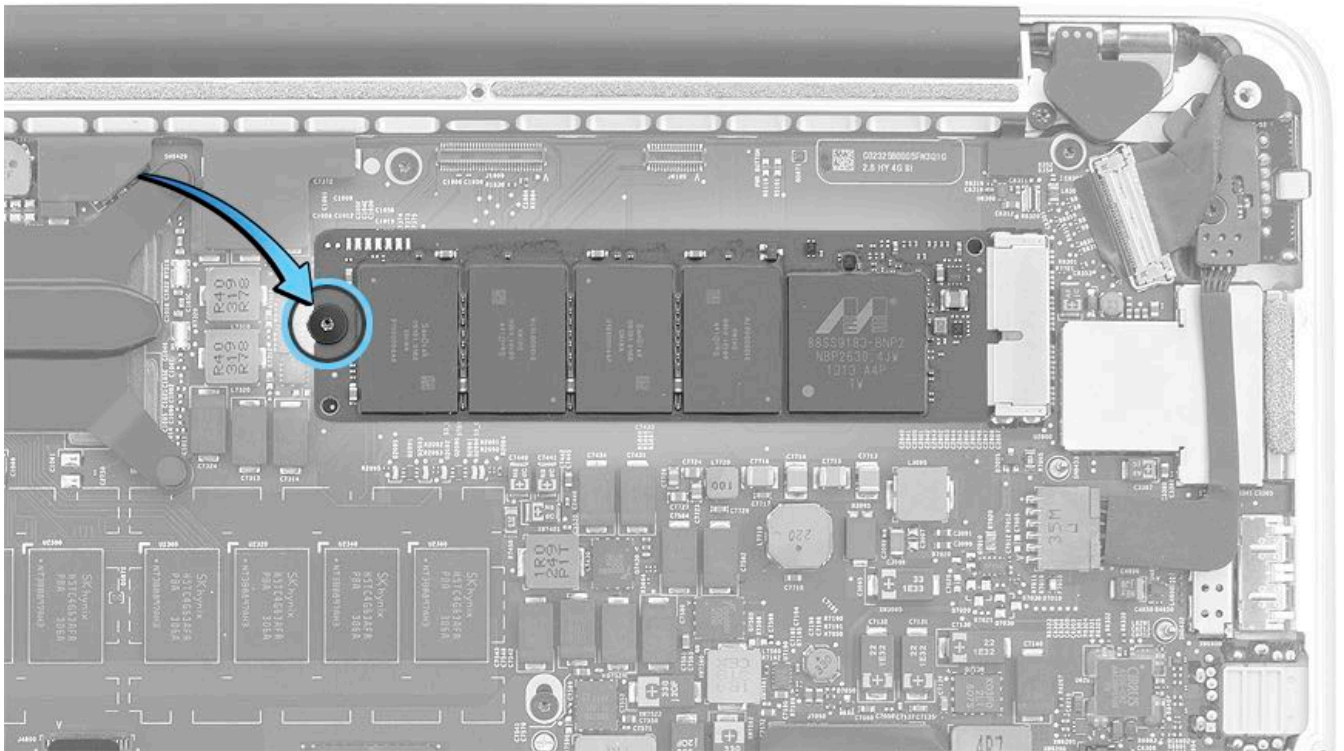
- ESD wrist strap
- Torx T5 screwdriver, magnetized



## Steps For Removal

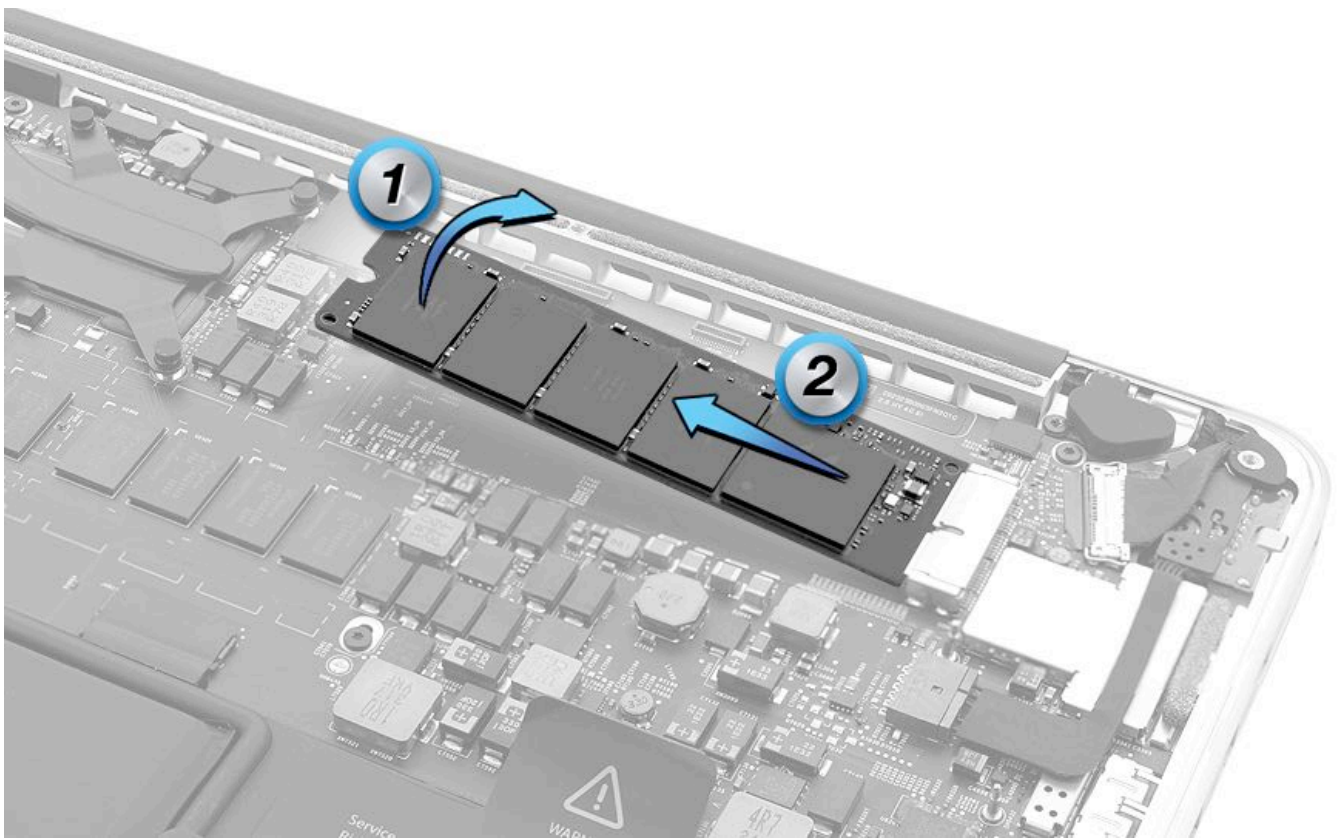
1. Remove one Torx T5 screw:

- 923-0161 (2.88mm)



2. Tilt card up (1) and gently pull flash storage out (2) of connector to disconnect.





3. Record the serial number. Copy the original serial number when reporting a flash storage return to Apple.

#### MacBook Pro (Retina, 13-inch, Late 2013 and Mid 2014) flash storage



#### MacBook Pro (Retina, 13-inch, Early 2015) flash storage



#### Steps For Reassembly

**Replacement Note:** Before installing a new flash storage card into the computer, peel off and discard the import compliance label, if present. This label is required to import the service part into certain countries, but is no longer relevant once the part

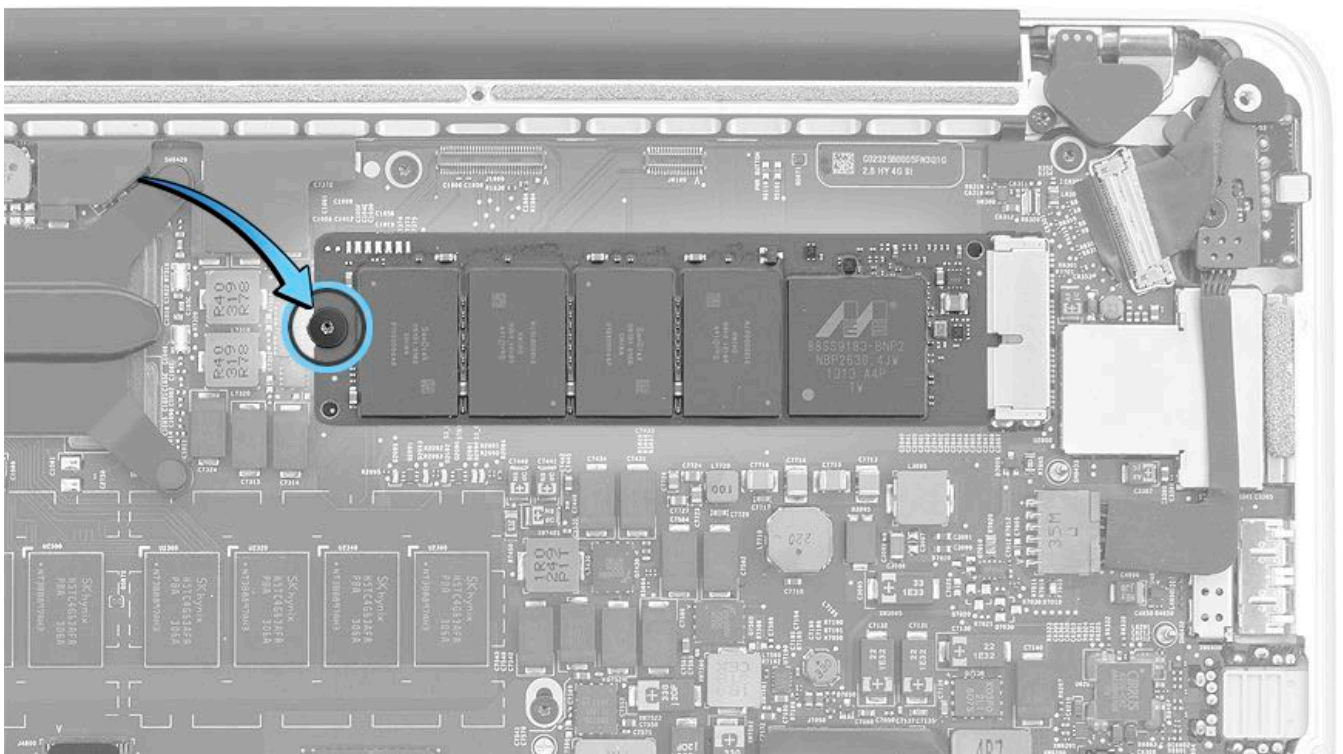
is installed into a computer.



1. Reassemble in reverse order of removal steps:

- Insert flash storage securely into slot and confirm it is seated properly.
- Install one Torx T5 screw:

923-0161 (2.88mm)



**2. MacBook Pro (Retina, 13-inch, Early 2015) only:** Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).



# Reinstalling Software That Came with the Computer

## Reinstalling Software That Came with the Computer

This procedure requires an Internet connection.

**Note:** In some situations, a user may have set a firmware password via a feature such as Find My Mac or FileVault. The user must know the firmware password in order to reinstall OS X or macOS. If the user cannot remember the password, then refer to the technician instructions in article [HT203409: If you lost or forgot your firmware password](#).

**Important:** Apple recommends that users back up their data before any software restore procedure. Back up essential files before installing OS X or macOS. Apple is not responsible for any loss of data.

1. Choose Apple menu > Restart, then hold down the Command (⌘) and R keys while the computer restarts.  
**Note:** To force OS X Lion or later, or macOS Sierra, into Internet Recovery, press and hold the Command-Option-R key combination while starting up the computer.
2. If the computer is not connected to the Internet, choose a network from the Wi-Fi menu (in the top-right corner of the screen).
3. Select "Reinstall OS X" (or macOS), then click Continue.
4. Follow the onscreen instructions. In the pane where you select a disk, select your current OS X or macOS disk (in most cases, it is the only one available).
5. To start the installation, click Install.

Check for and apply the latest software and firmware updates.

For more information, refer to article [HT201314: About macOS Recovery](#).

# MagSafe 2 Board

## First Steps

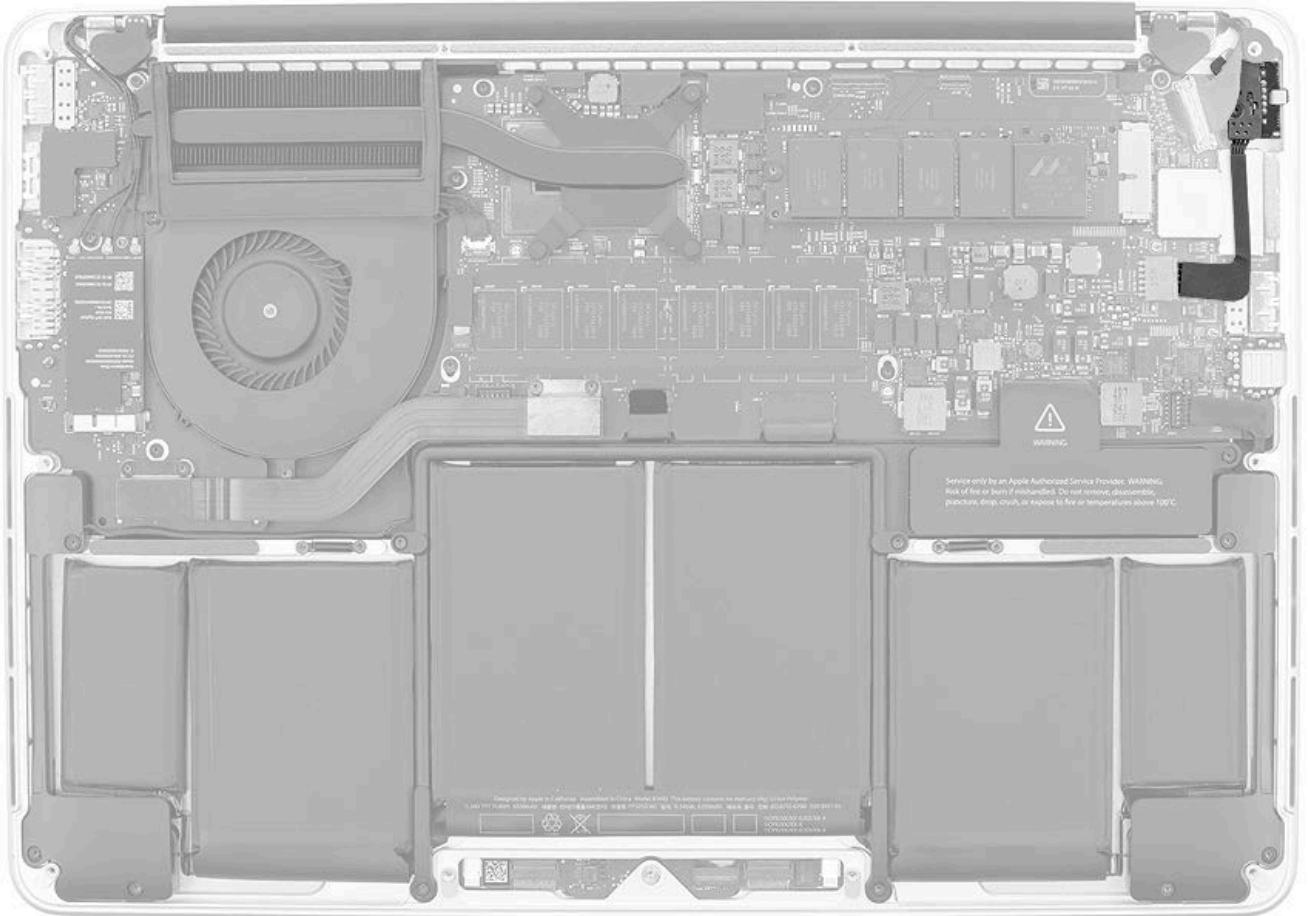
**Important:** This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT202594: Exams for Service Technicians](#).

Remove:

- [Bottom case](#)

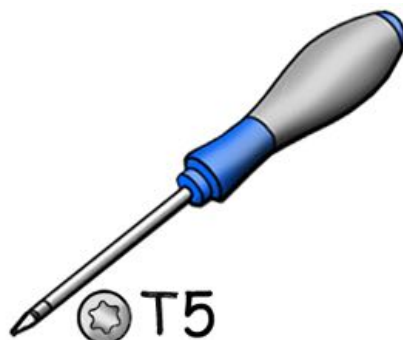
**Important:**

- Always wear an ESD wrist strap and take precautions to avoid ESD.
- Always [attach the battery cover and disconnect the battery](#) immediately after removing the bottom case.



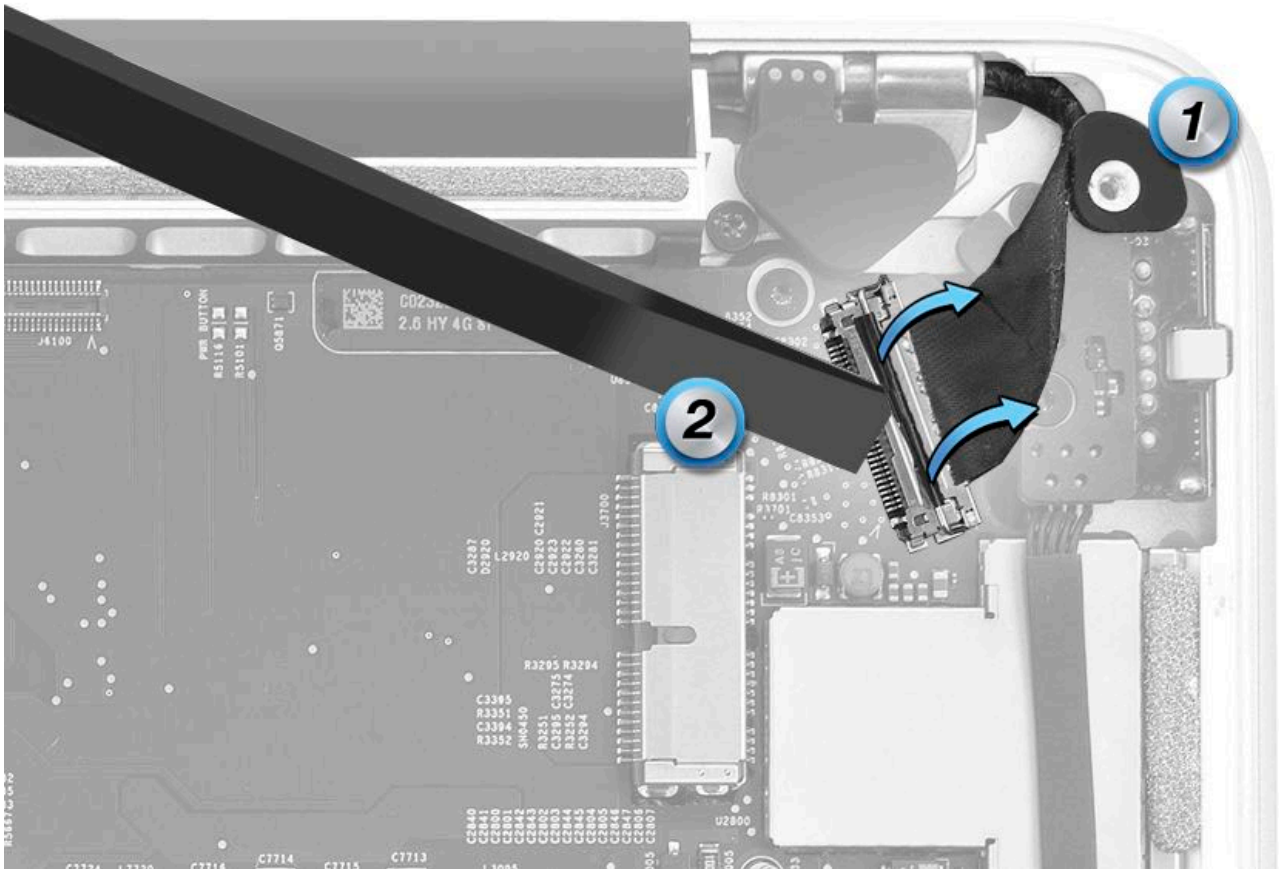
## Tools

- ESD wrist strap
- Torx T5 screwdriver (magnetized)
- Black stick

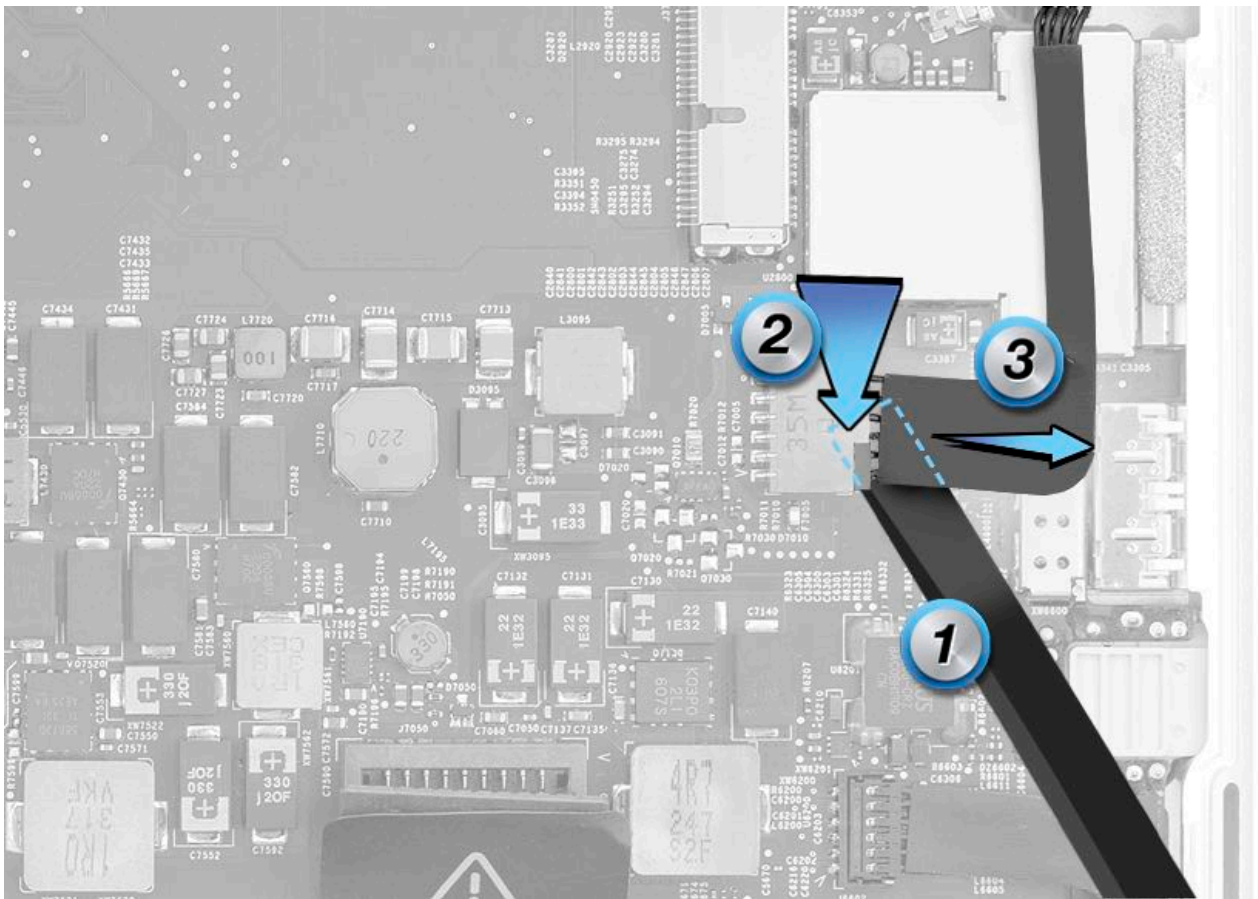


## Steps For Removal

1. Use a black stick to remove the black gasket (1). **Note:** MacBook Pro (Retina, 13-inch, Early 2015) does not have a corner gasket.
2. Use a black stick to lift the metal lock bar (2) on the embedded DisplayPort (eDP) cable. Disconnect the eDP cable by gently pulling the cable out of the connector.

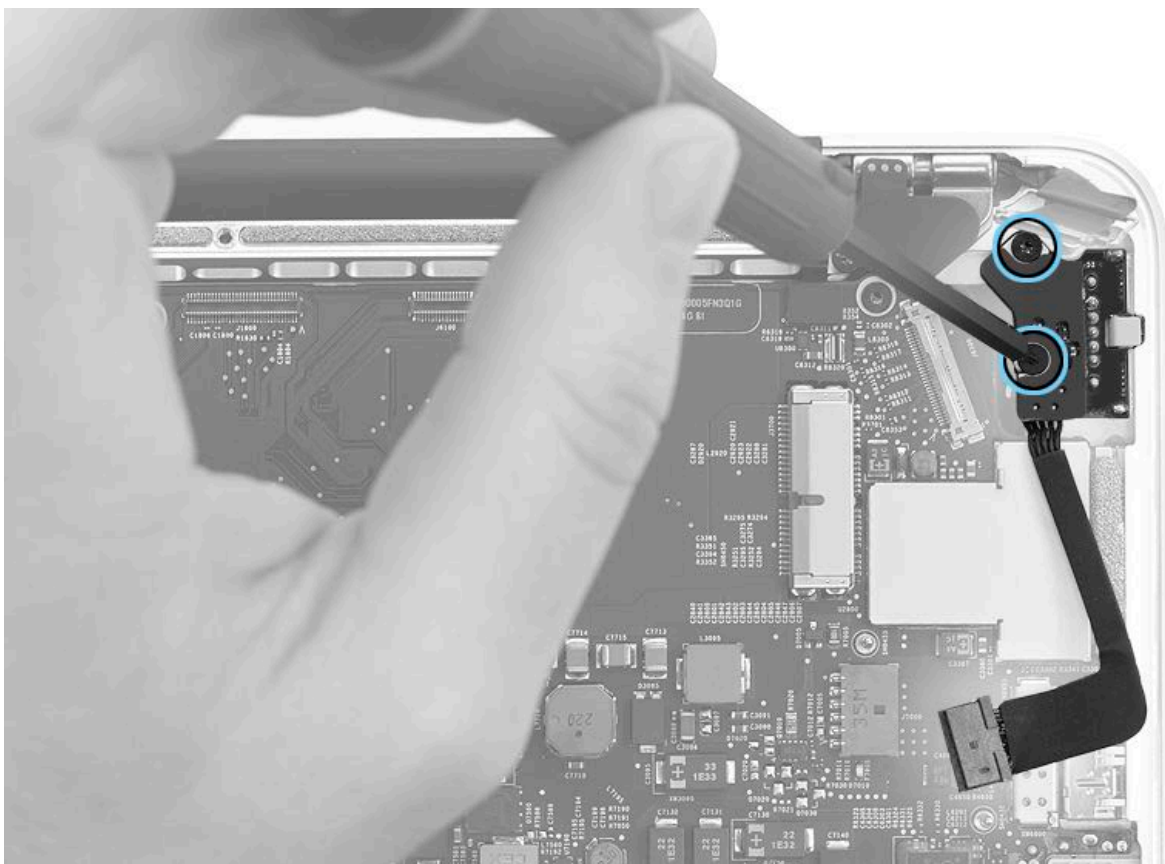


3. To support the cable during removal, slide the black stick (1) under the cable and place your thumb on top of the cable (2), near the connector. With the cable between the black stick and your thumb, squeeze the black stick and cable together as you gently pull the cable (3) to the right, out of the connector.



4. Use the Torx T5 screwdriver to remove two T5 screws (923-0235).

5. Remove the MagSafe 2 board by tilting up slightly and lifting out.



## Steps For Reassembly

1. If installing a replacement MagSafe 2 board, discard the bar code label (if present), then peel the adhesive backing off the cable and install the MagSafe 2 board into the top case. **Important:** Make sure the MagSafe 2 board is seated securely against the top case port hole when installing.



2. Connect the embedded DisplayPort (eDP) cable.
3. Replace the black corner gasket. **Note:** MacBook Pro (Retina, 13-inch, Early 2015) does not have a corner gasket.
4. Replace the [bottom case](#).
5. **MacBook Pro (Retina, 13-inch, Early 2015) only:** Verify trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).



# Heat Sink

## First Steps

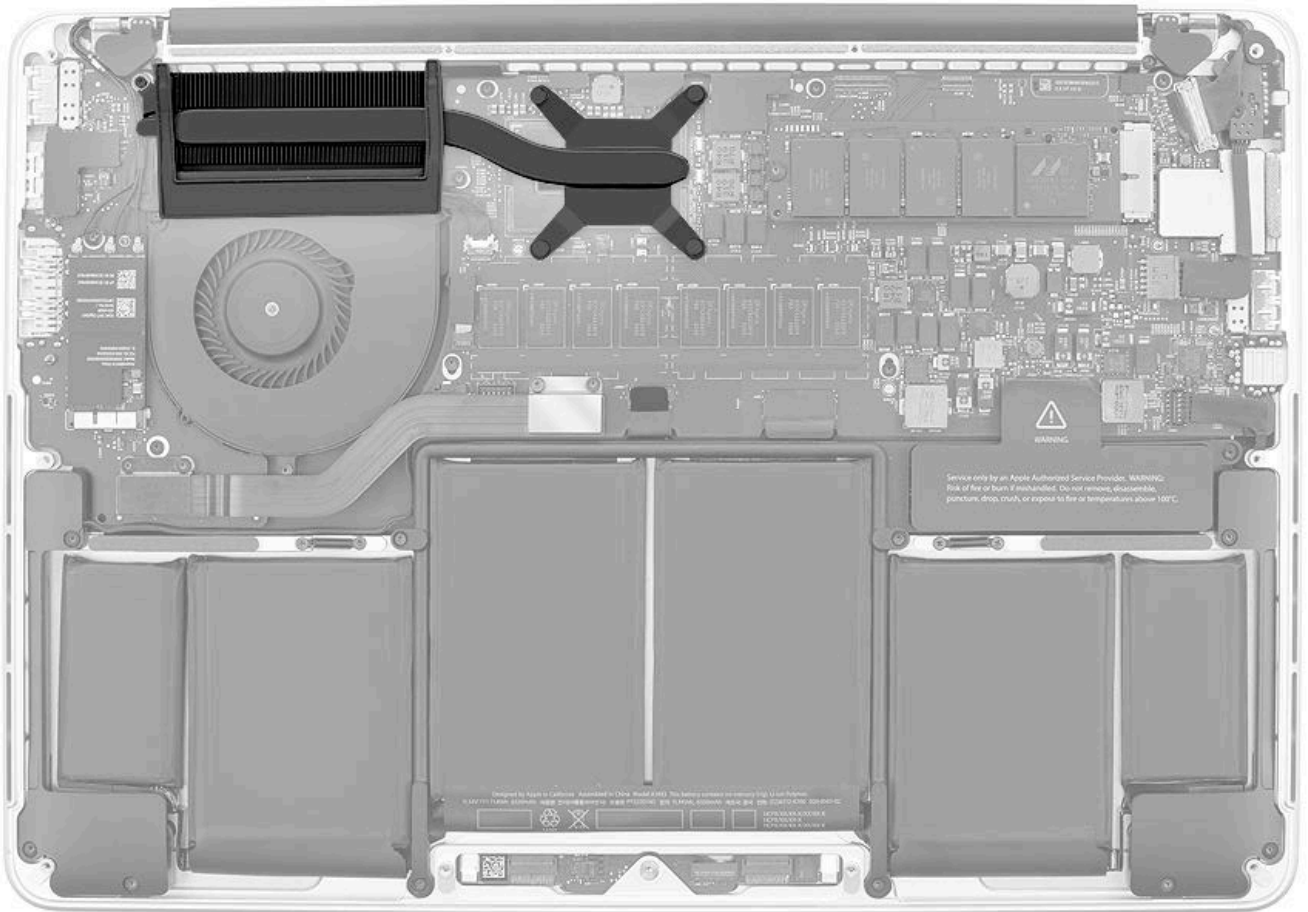
**Important:** This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT202594: Exams for Service Technicians](#).

Remove:

- [Bottom Case](#)

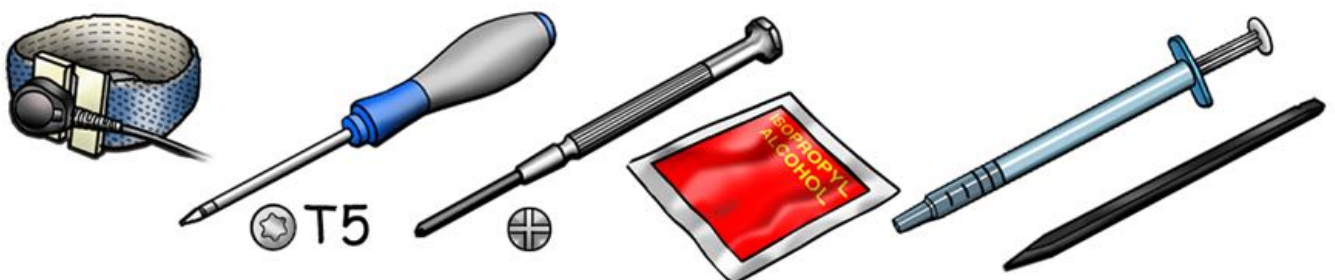
### IMPORTANT:

- Always wear ESD wrist strap and take precautions to avoid ESD.
- Always [attach battery cover and disconnect the battery](#) immediately after removing bottom case.



## Tools

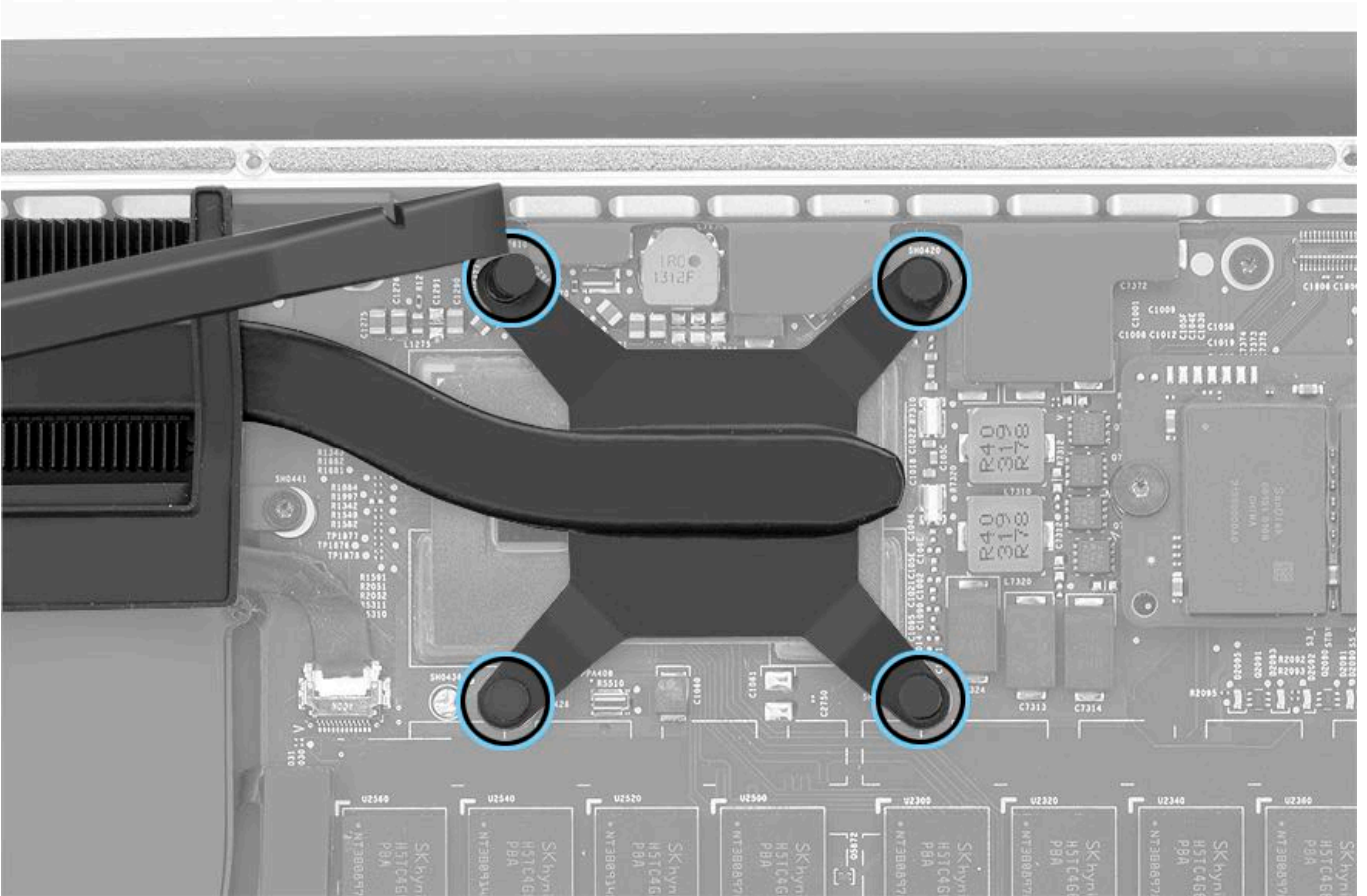
- ESD wrist strap
- Torx T5 screwdriver, magnetized
- Phillips #0 screwdriver, magnetized
- Isopropyl alcohol (IPA) wipes
- Thermal grease syringe (922-7144)
- Black stick





## Steps For Removal

1. Remove and set aside four rubber screw bumpers.



2. Remove in the following order:

### **Screw 1:** Phillips #0

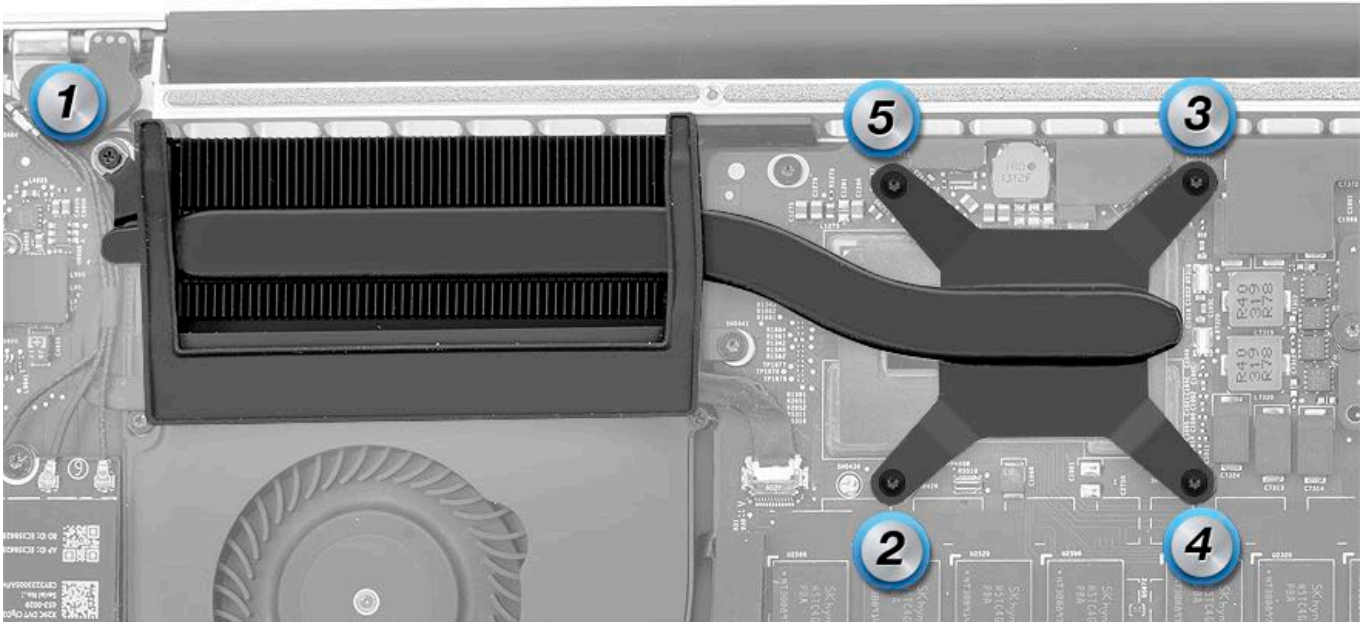
- 923-0238 (Late 2012, Early 2013, Late 2013, Mid 2014)
- 923-00605 (Early 2015)

**Note:** Some Early 2015 models may have a T5 screw #1, which was later phased out.



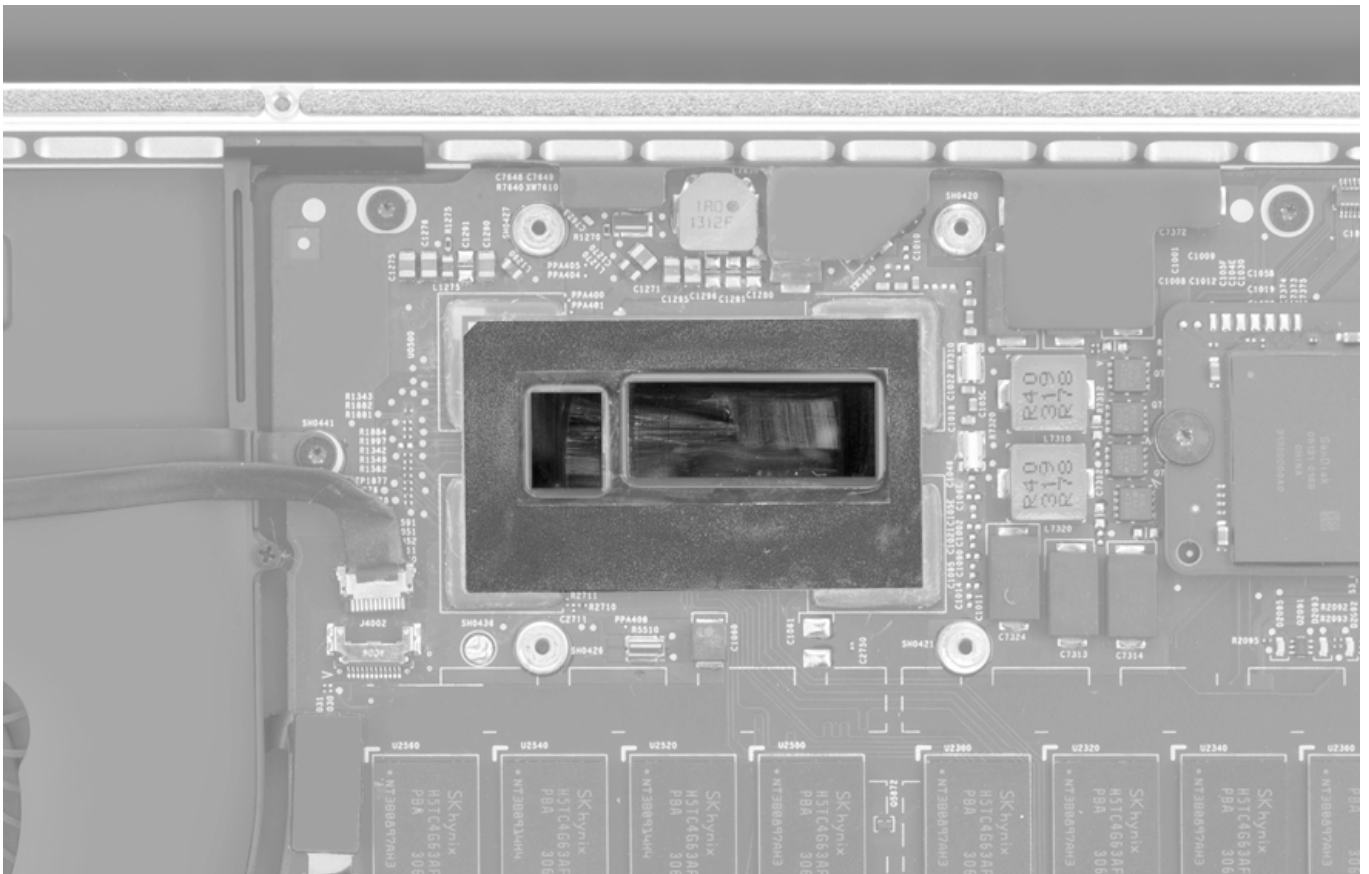
### **Screws 2 - 5:** Four T5 screws (2.57 mm) 923-0140.





3. Grasp heat sink and fan gasket with hands and carefully pull up and away. Use black stick to help detach heat sink and fan duct if needed.

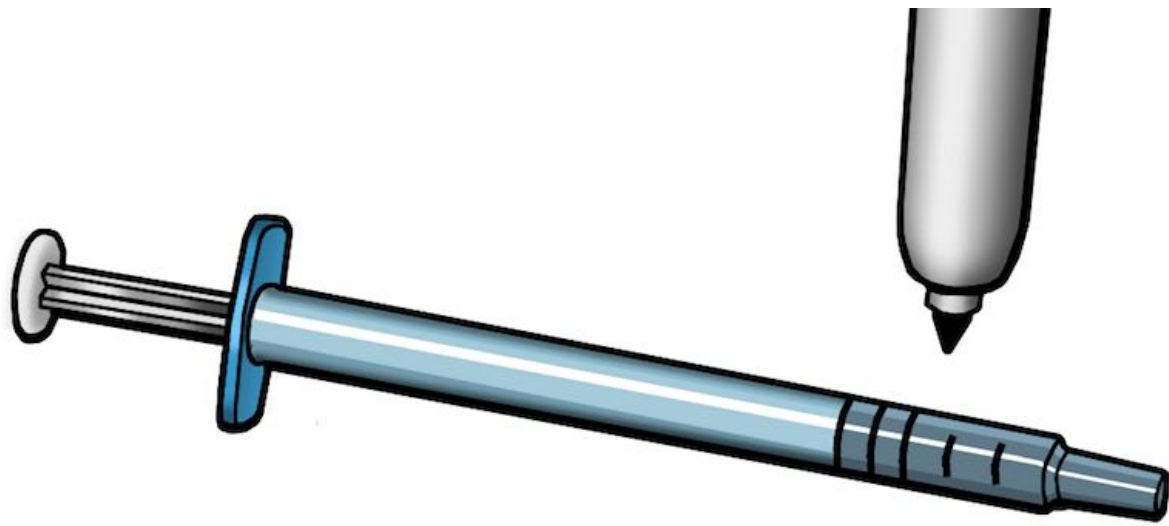
4. Use IPA wipes to clean thermal pads and chips of any residual thermal grease.



## Steps For Reassembly

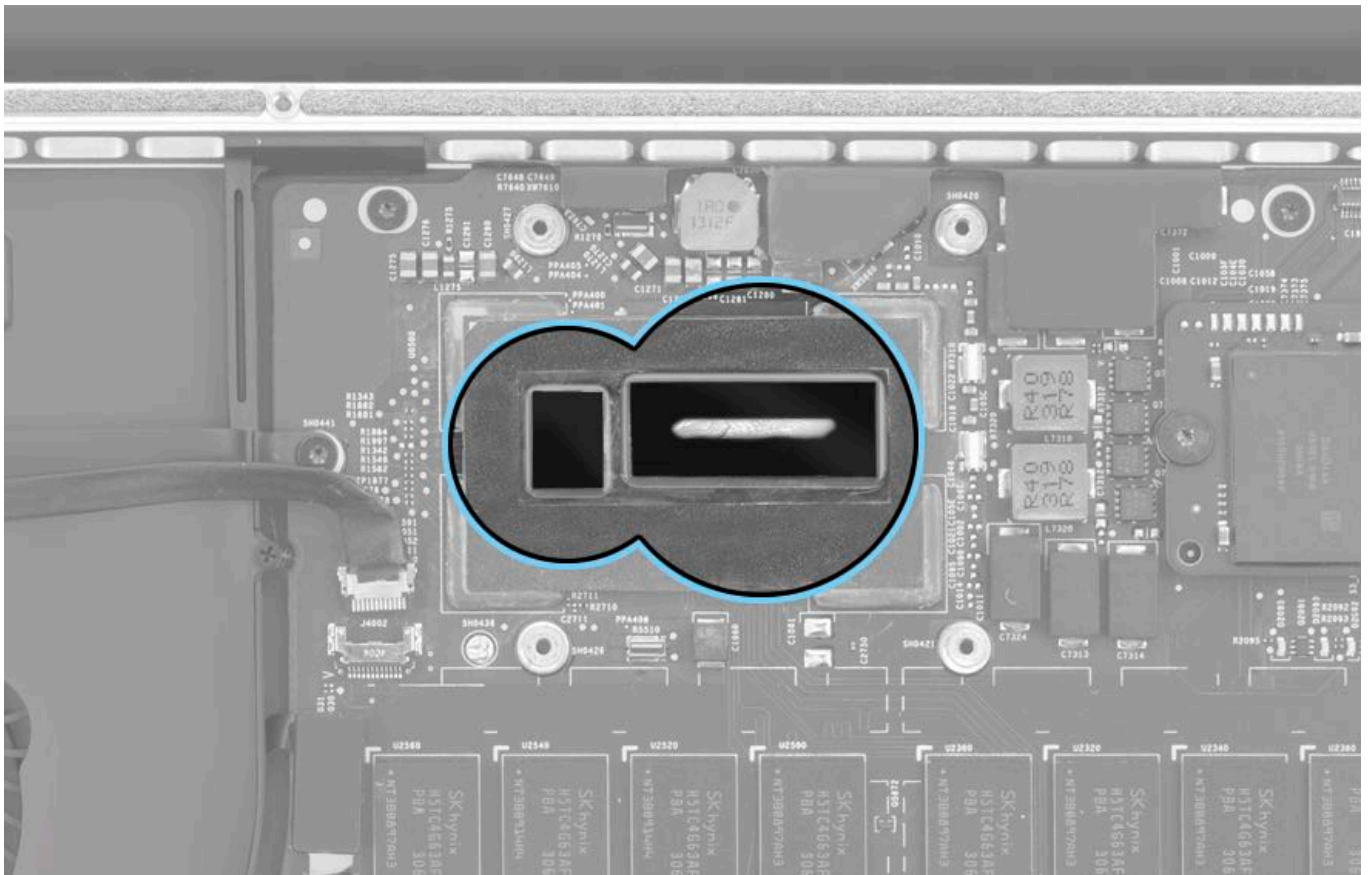
1. Use a pen to mark the syringe in thirds.

**Caution:** Syringe (922-7144) contains enough thermal grease for three chips. Because thermal grease is only needed for one chip, use only one-third of syringe contents.



2. Inject one-third of the syringe on the larger chip **only**. Apply a thin straight line along the center length of the larger chip from right to left.

**IMPORTANT:** Apply thermal grease **only** to the larger chip.



3. Install heat sink and fan duct on logic board.

4. Replace five screws in order indicated. Install screws halfway first; then tighten in same order.

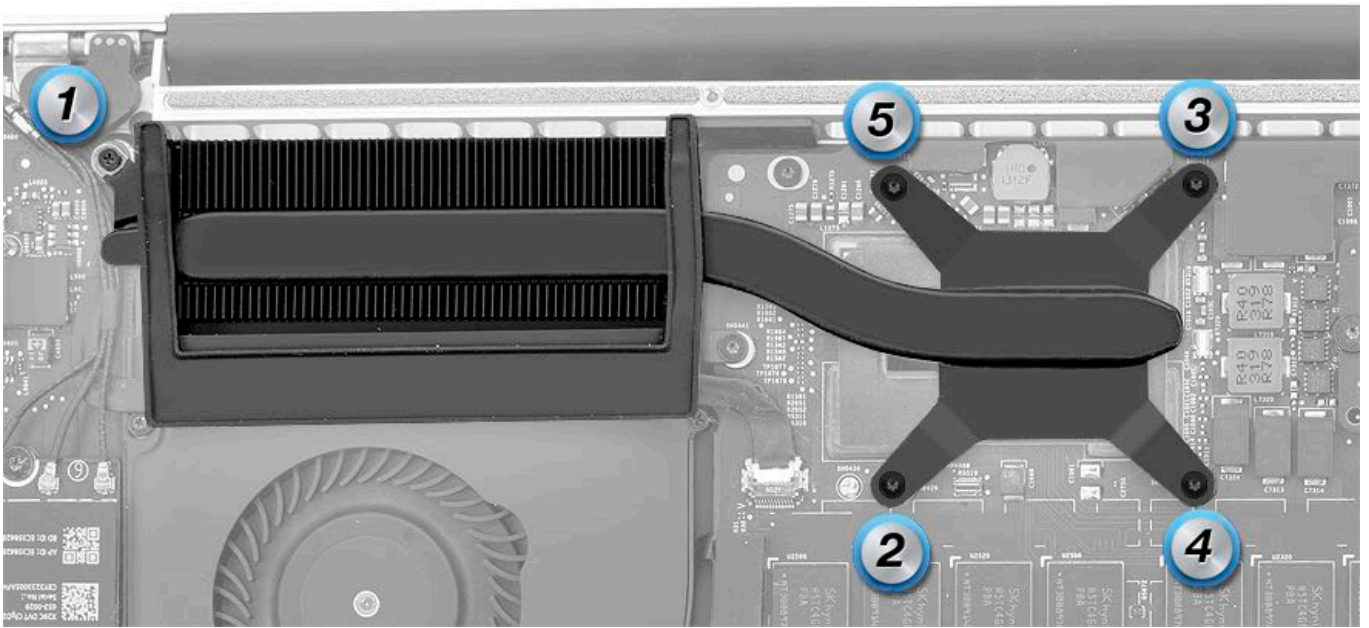
**Screw 1:** Phillips #0

- 923-0238 (Late 2012, Early 2013, Late 2013, Mid 2014)
- 923-00605 (Early 2015)

**Note:** Some Early 2015 models may have a T5 screw #1, which was later phased out. If replacing this screw, use the Phillips #0 part number listed here.



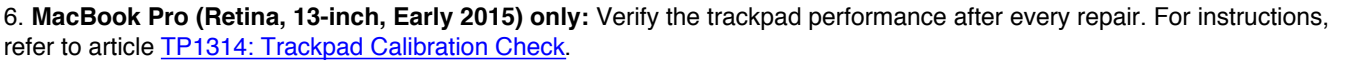
**Screw 2 - 5:** Four T5 screws (2.57 mm) 923-0140.



**5. Important:** Adhere four rubber bumpers so they are centered on the four heat sink screws . They help protect the microprocessor from sudden impact to the computer case.

If needed, you can order a replacement kit of five rubber bumpers (923-0295).





# Fan

## First Steps

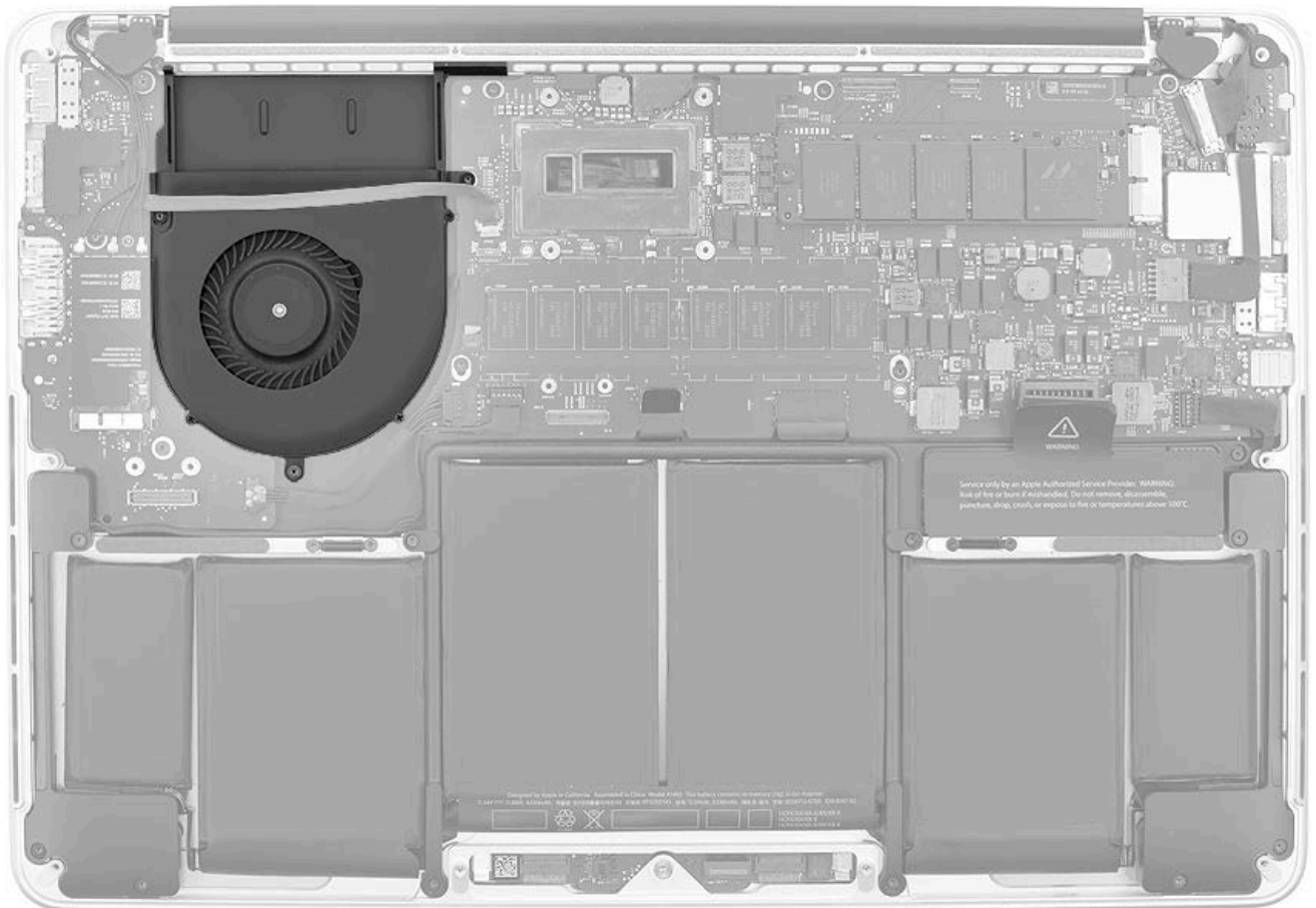
**Important:** This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT202594: Exams for Service Technicians](#).

Remove:

- [Bottom Case](#)
- [I/O Flex Cable](#)
- [Heat Sink](#)

### IMPORTANT:

- Always wear ESD wrist strap and take precautions to avoid ESD.
- Always [attach battery cover and disconnect the battery](#) immediately after removing bottom case.



## Tools

- ESD wrist strap
- Torx T5 screwdriver, magnetized
- Black stick

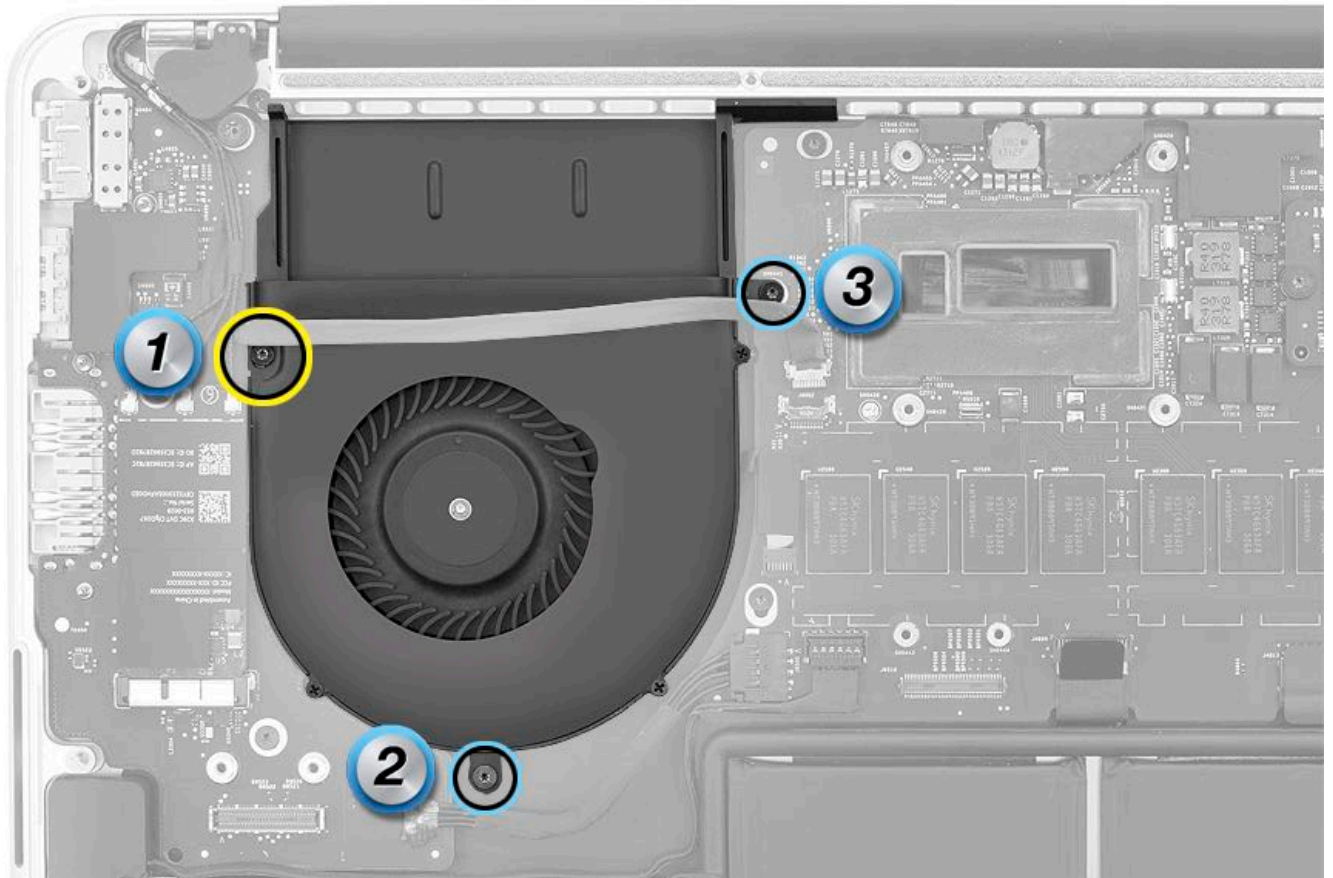


## Steps For Removal



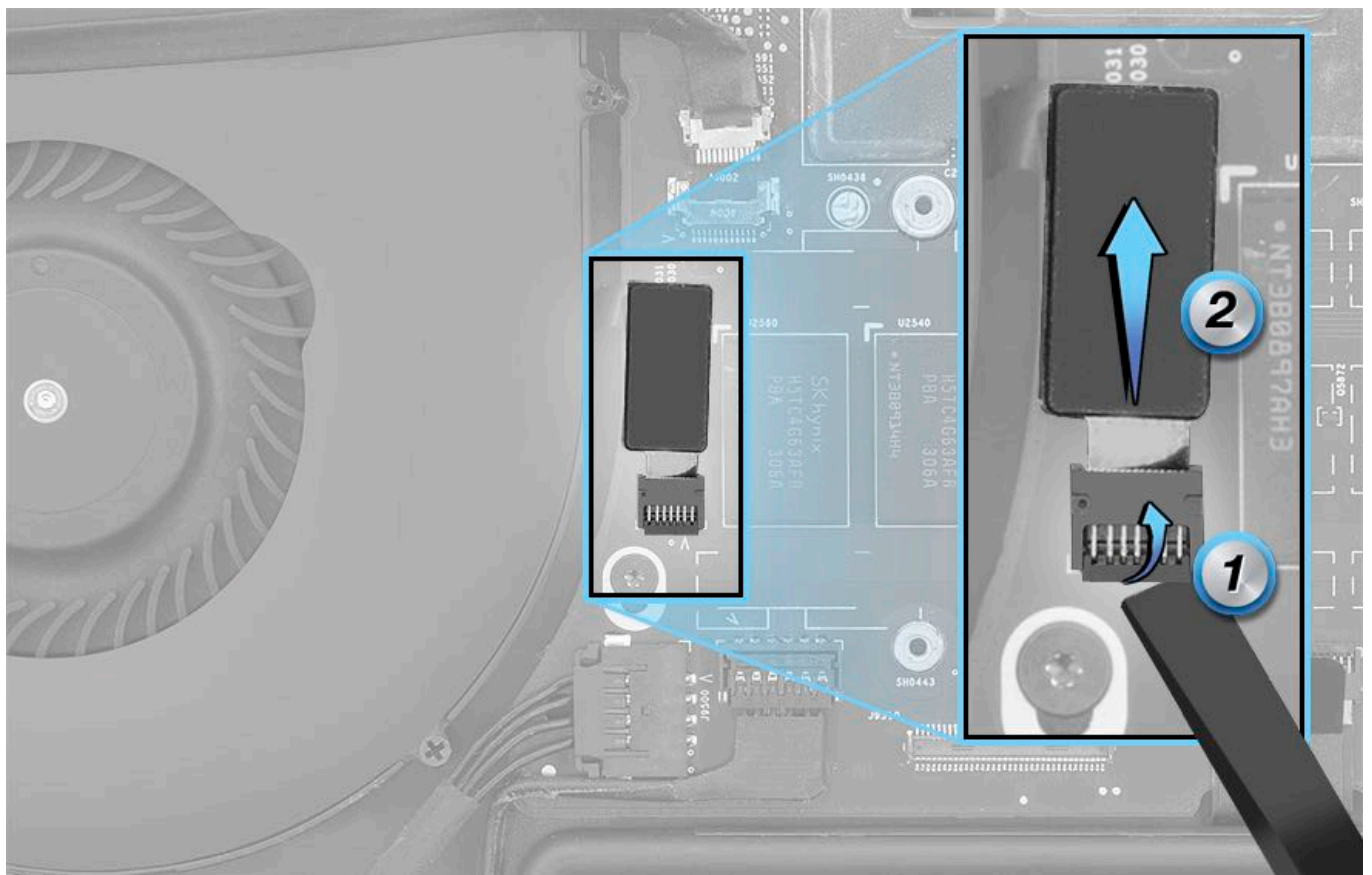
Screw 1 - (923-00109) This screw is slightly longer than screws 2 and 3.

Screws 2 and 3 - (923-0646).

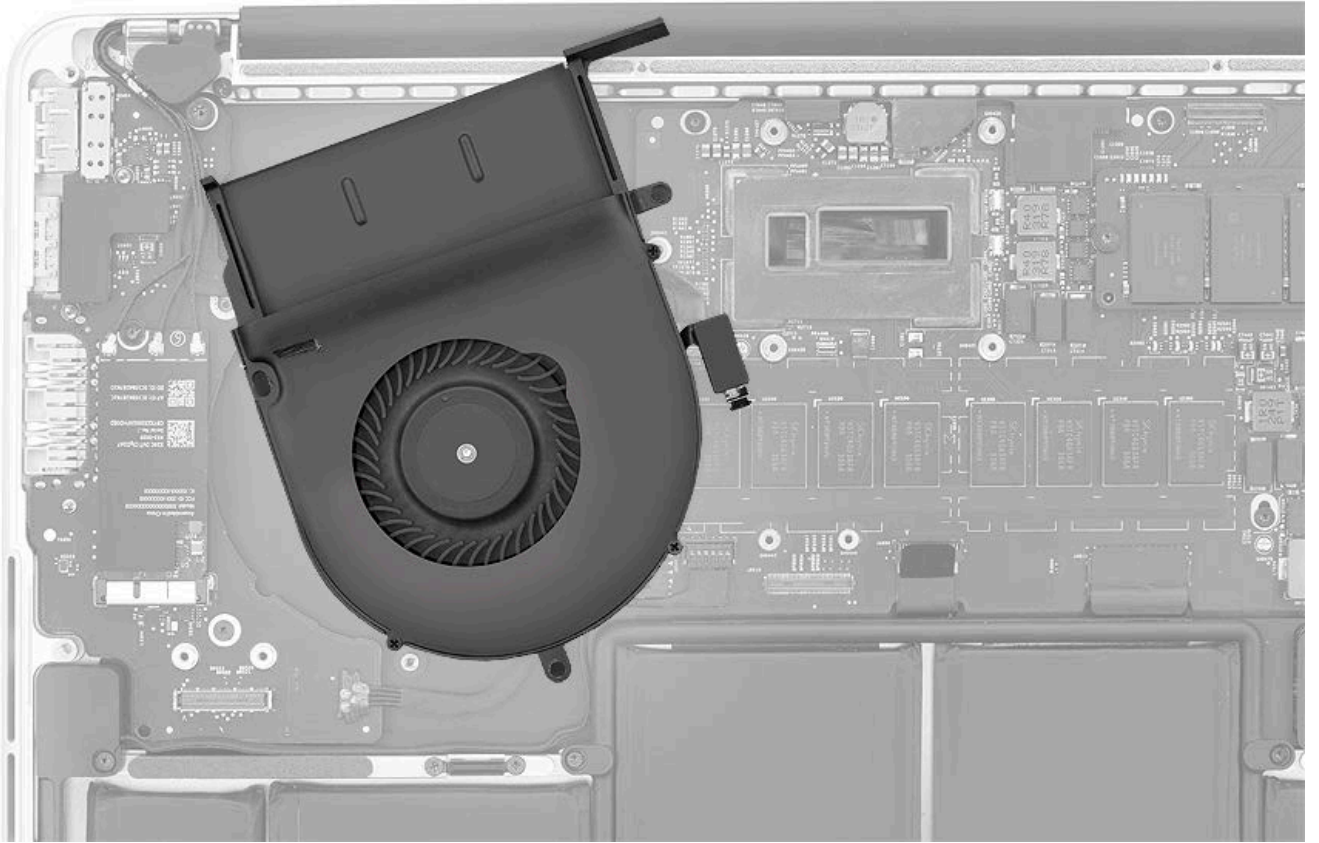


3. Use a black stick to flip up locking lever (1) of fan cable and carefully separate cable (2) from logic board and disconnect cable.

**IMPORTANT:** Flip down locking lever after disconnecting fan cable to avoid damaging locking lever.



4. Tilt up top end of fan to remove it.



## Steps For Reassembly

1. Reassemble in reverse order of removal steps.
2. **MacBook Pro (Retina, 13-inch, Early 2015) only:** Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).

# Input/Output (I/O) Board

## First Steps

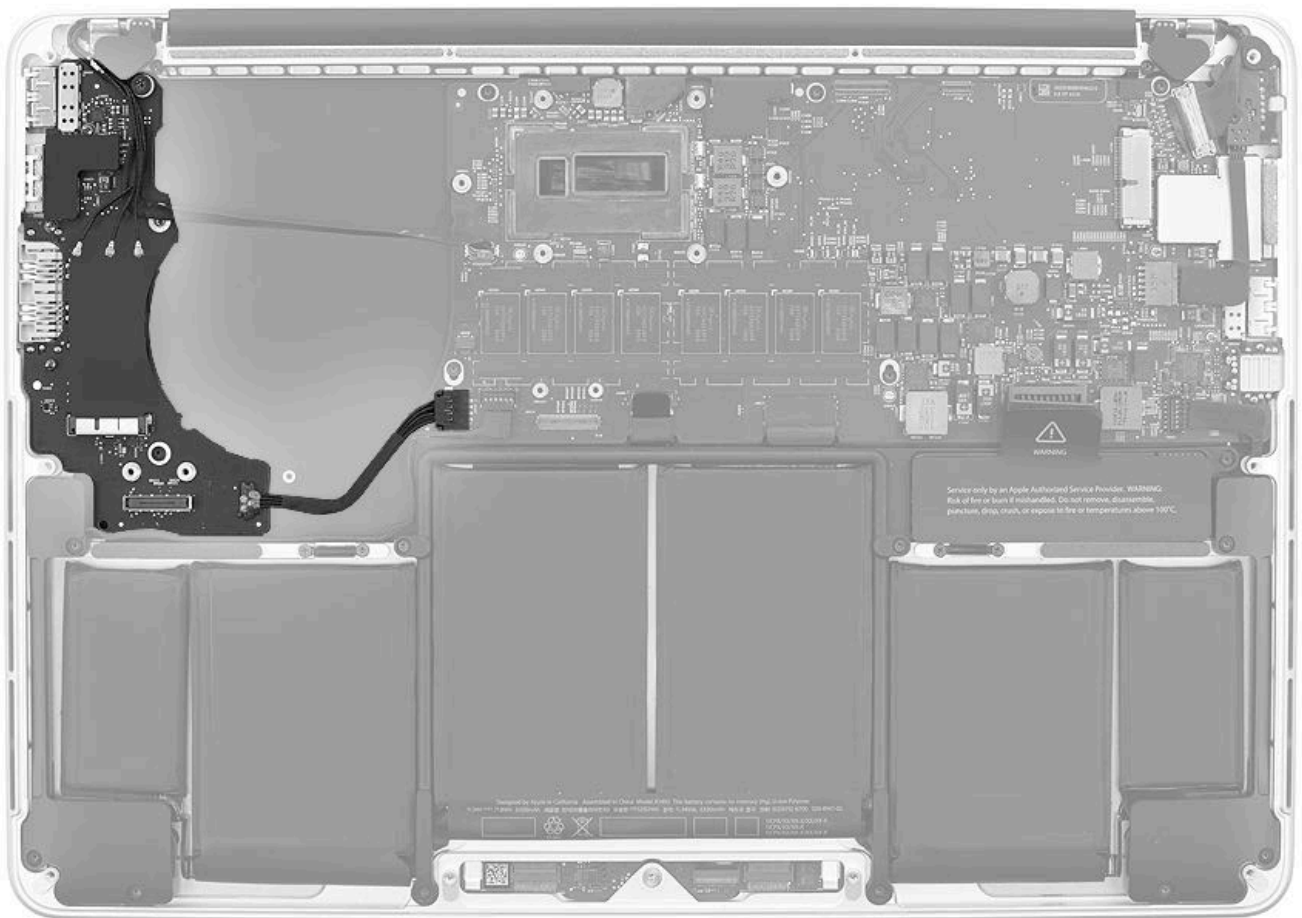
**Important:** This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT202594: Exams for Service Technicians](#).

Remove:

- [Bottom Case](#)
- [I/O Flex Cable](#)
- [Wireless Card](#)
- [Heat Sink](#)
- [Fan](#)

## IMPORTANT:

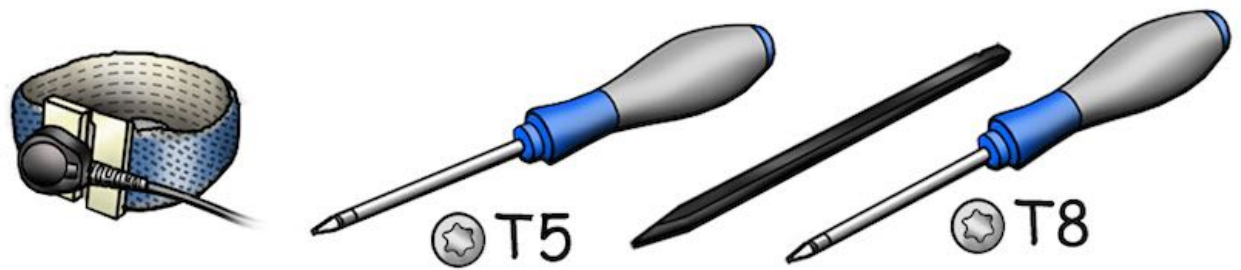
- Always wear ESD wrist strap and take precautions to avoid ESD.
- Always [attach battery cover and disconnect the battery](#) immediately after removing bottom case.



## Tools

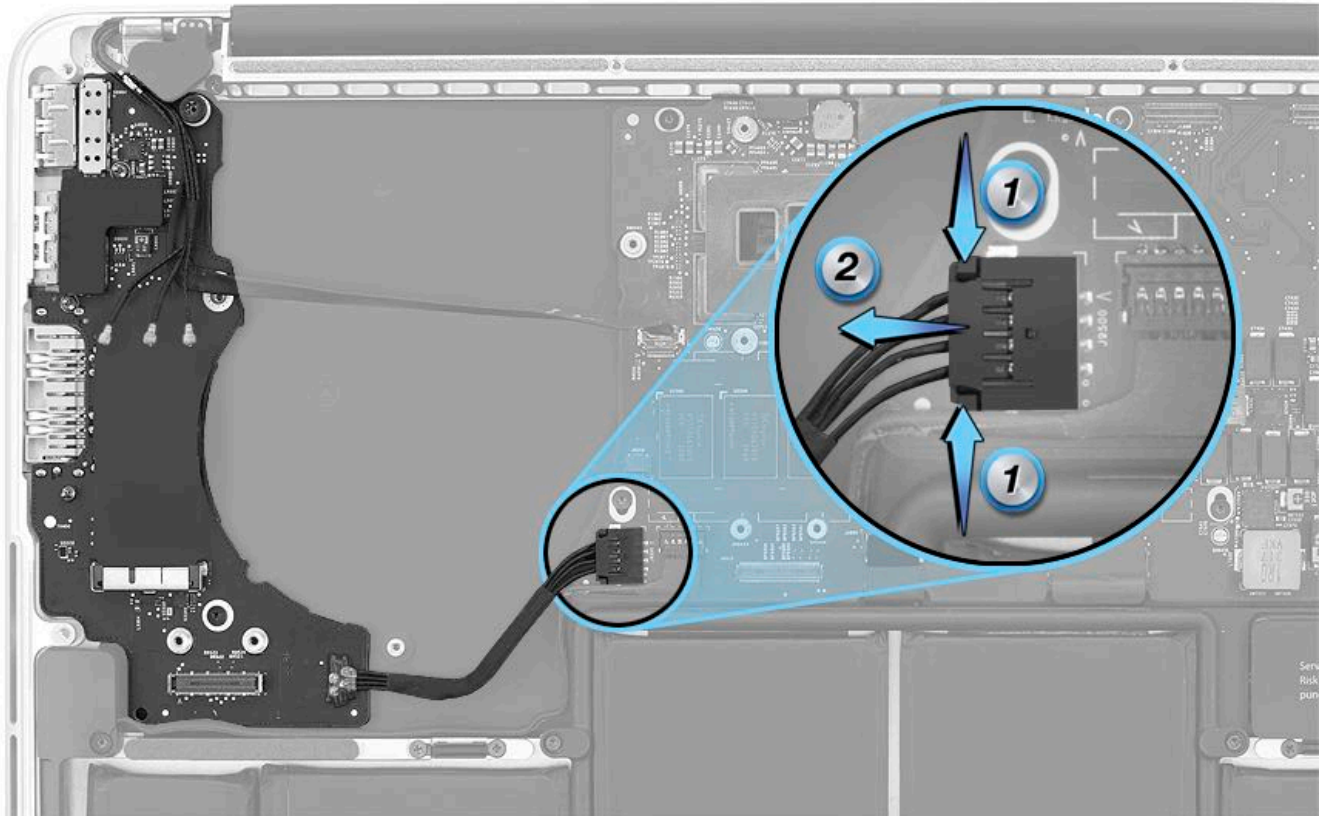
- ESD wrist strap
- Torx T5 screwdriver, magnetized
- Black stick
- Torx T8 screwdriver, magnetized





## Steps For Removal

1. Disconnect I/O cable by pressing in on connector tabs (1) and pulling cable straight out from receptacle (2) on logic board.



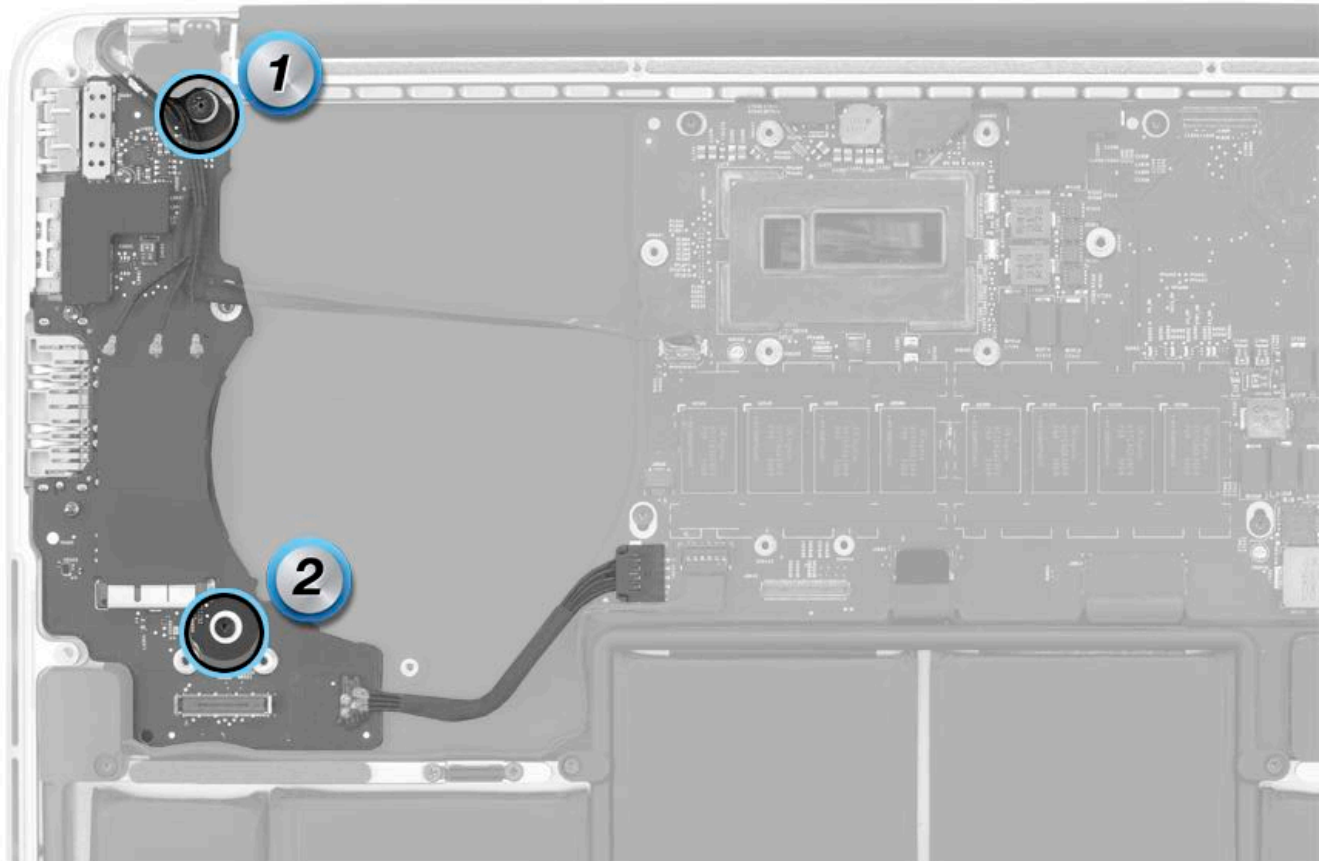
2. Remove two screws:

- One T8 screw (1), 923-0237



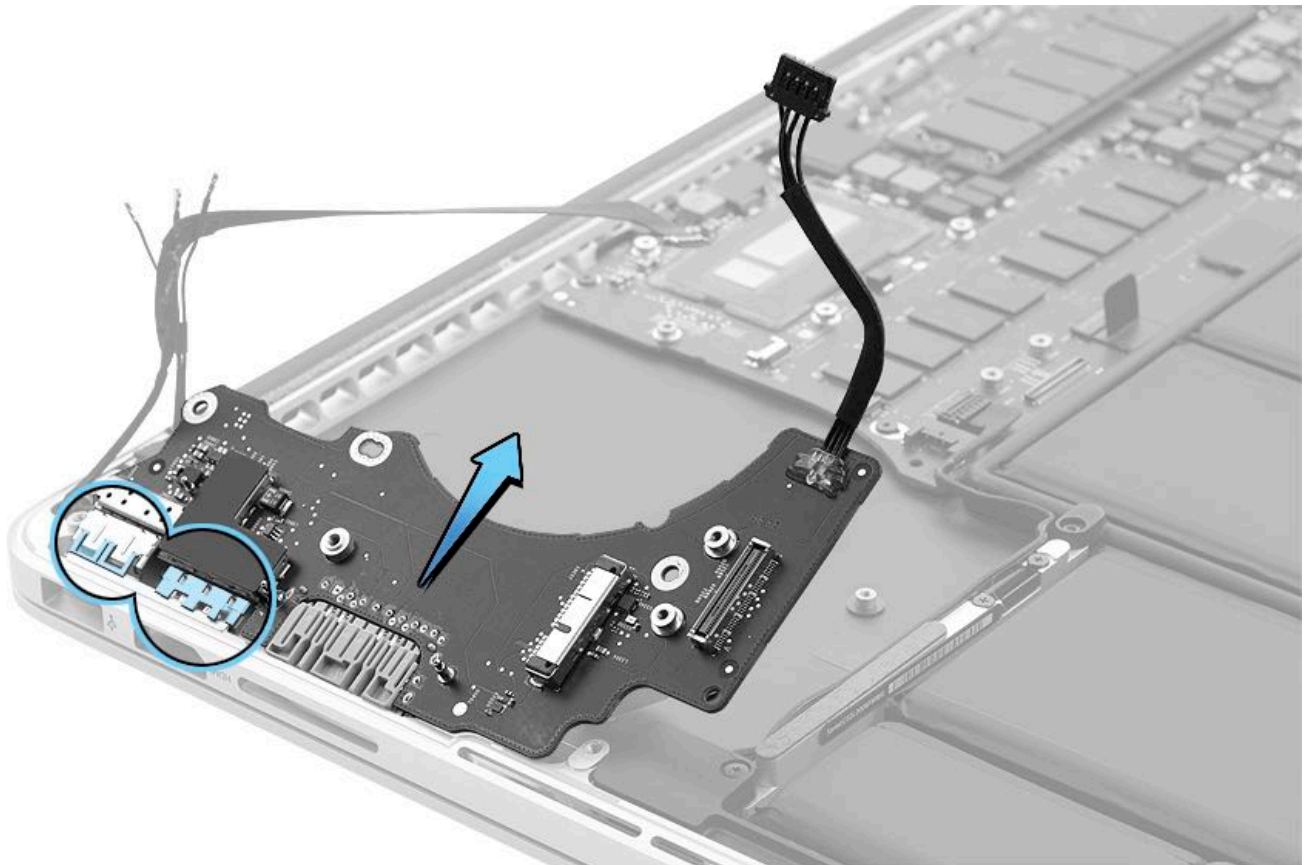
- One T5 screw (2), 923-0235





3. Slightly tilt I/O board up and gently pull out.

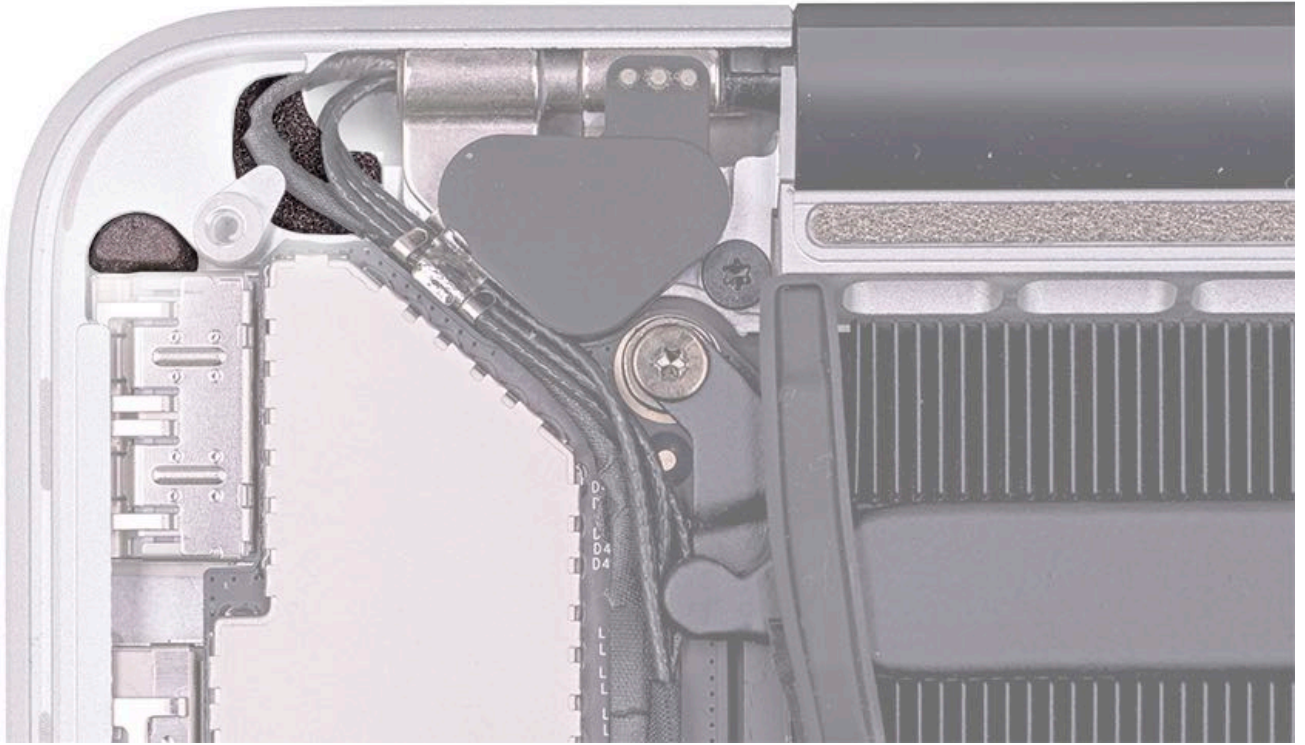
**Caution:** Be careful not to damage EMI ground tabs.



## Steps For Reassembly

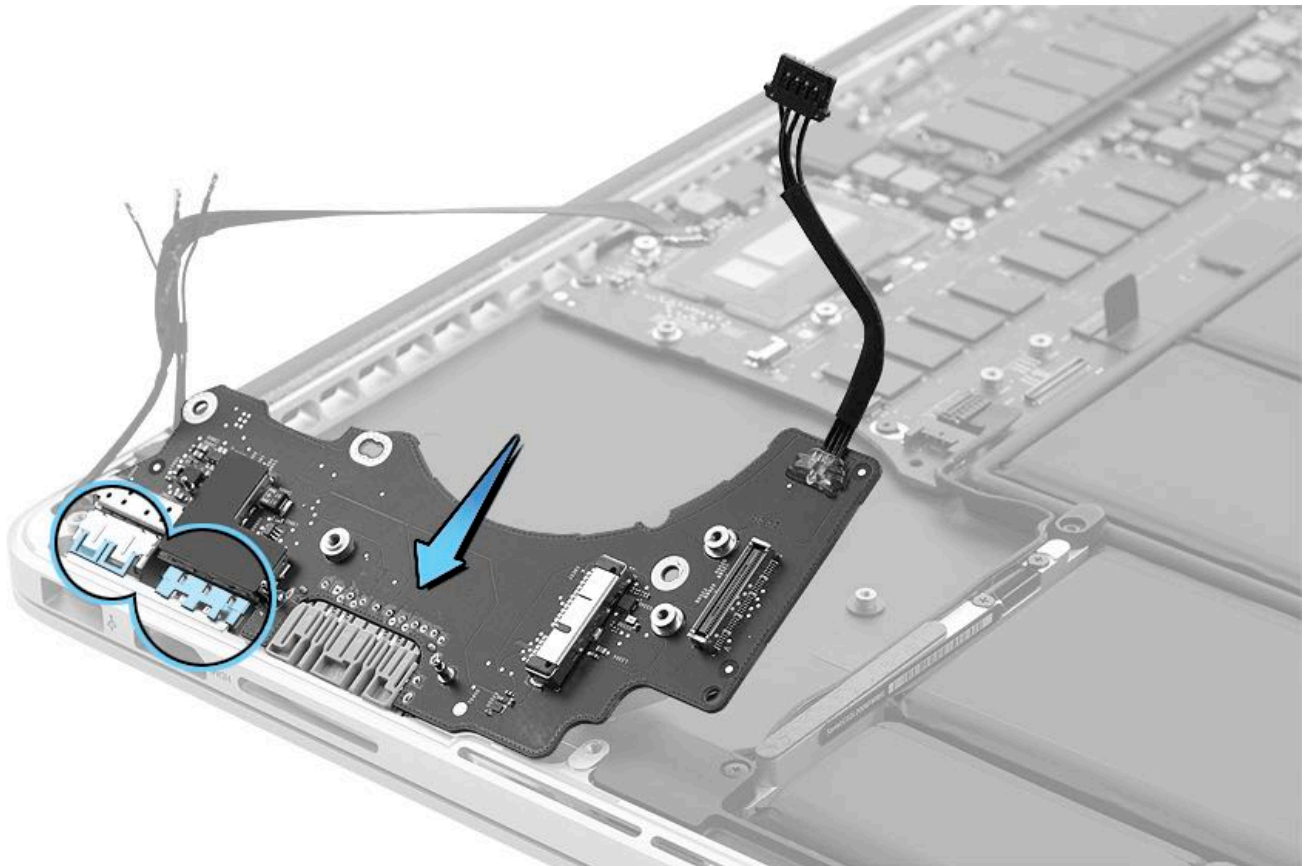
1. **MacBook Pro (Retina, 13-inch, Early 2015):** Check that two foam gaskets are present in the top case before installing the I/O board. Previous models have only the larger foam gasket.





2. Tilt the port side of I/O board into top case.

3. Make sure metal EMI ground tabs on USB 3 and HDMI ports tuck **under** lip of top case. Press the tabs with a fingernail, if necessary, to tuck them under lip.



4. Continue reassembly in reverse order of removal steps.

5. When returning an I/O board to Apple service, install the two protective port covers (transferred from the replacement board) on the defective I/O board. They offer protection during shipment and handling.

6. **MacBook Pro (Retina, 13-inch, Early 2015) only:** Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).

# Trackpad Flex Cable

## First Steps

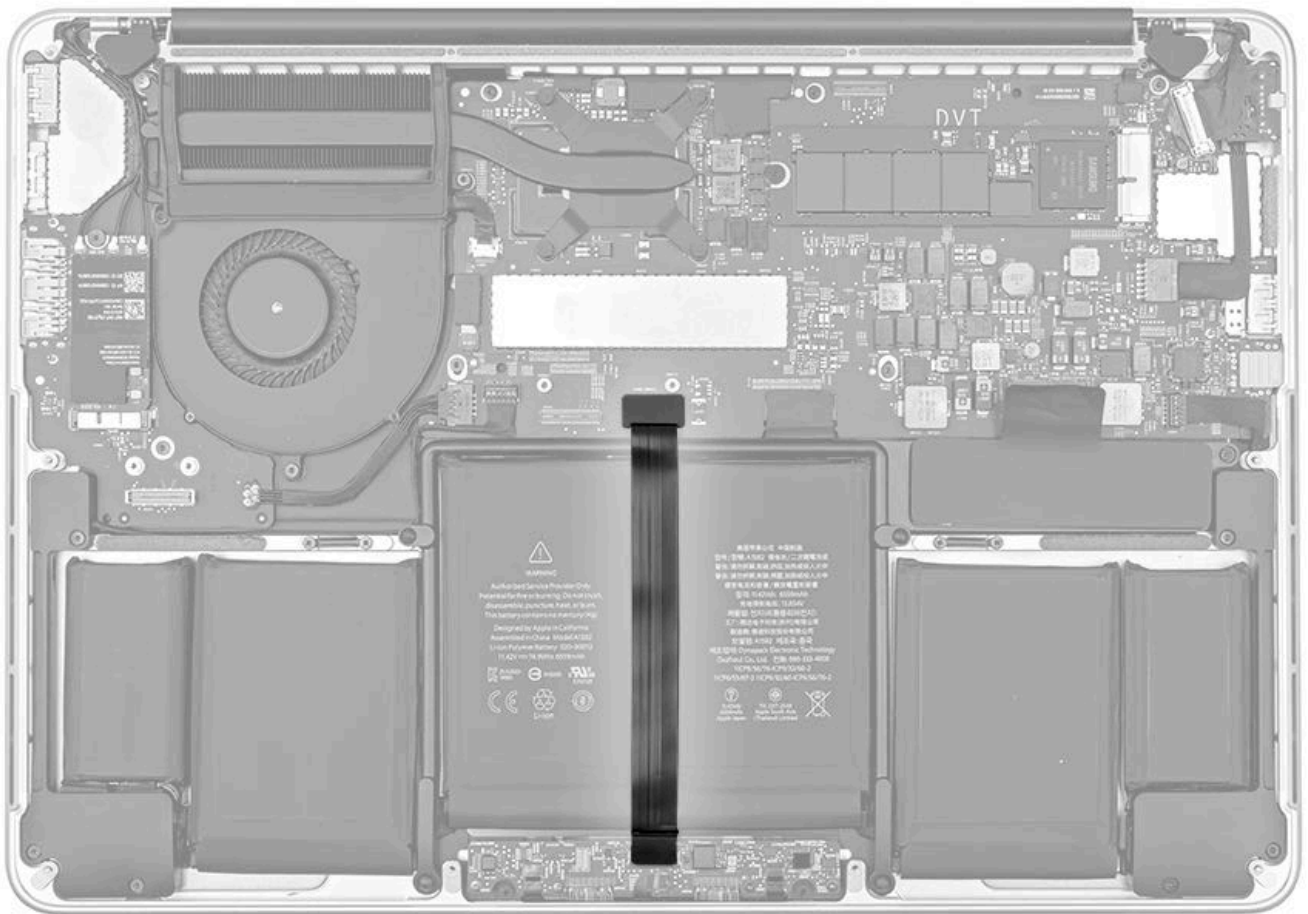
**Important:** This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT202594: Exams for Service Technicians](#).

Remove:

- [Bottom Case](#)
- [I/O Flex Cable](#)

### IMPORTANT:

- Always wear ESD wrist strap and take precautions to avoid ESD.
- Always [attach battery cover and disconnect the battery immediately after removing bottom case](#).



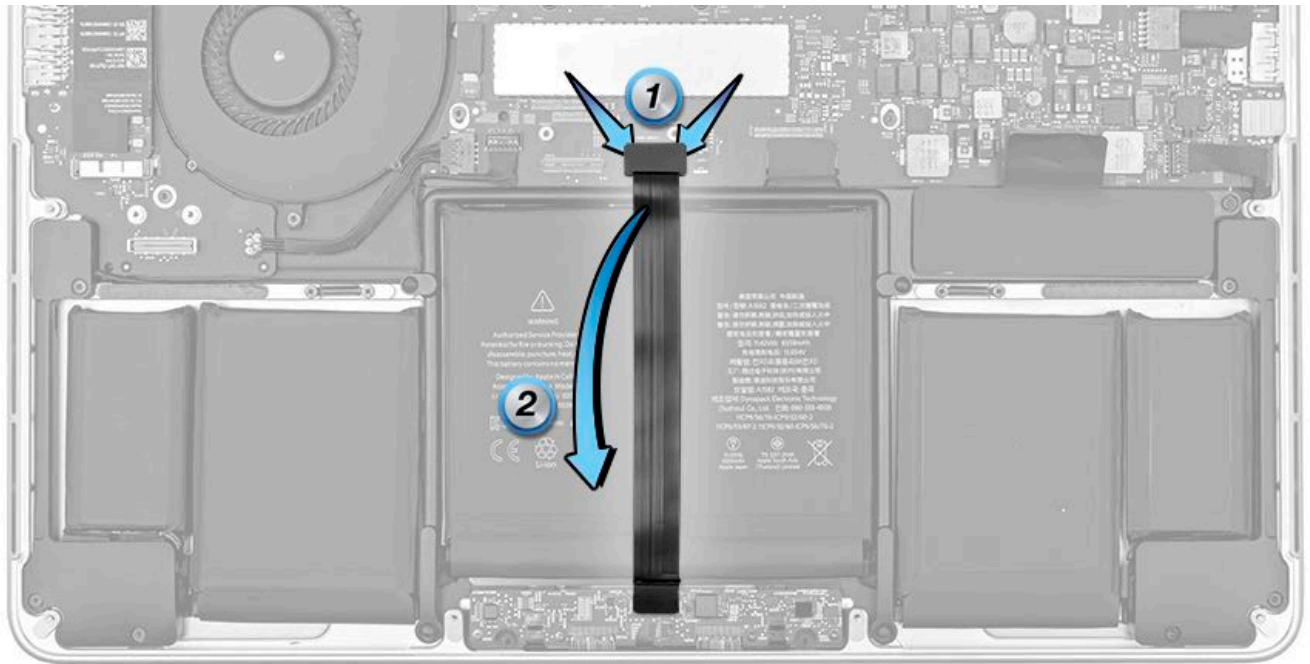
## Tools

- ESD wrist strap
- Black stick

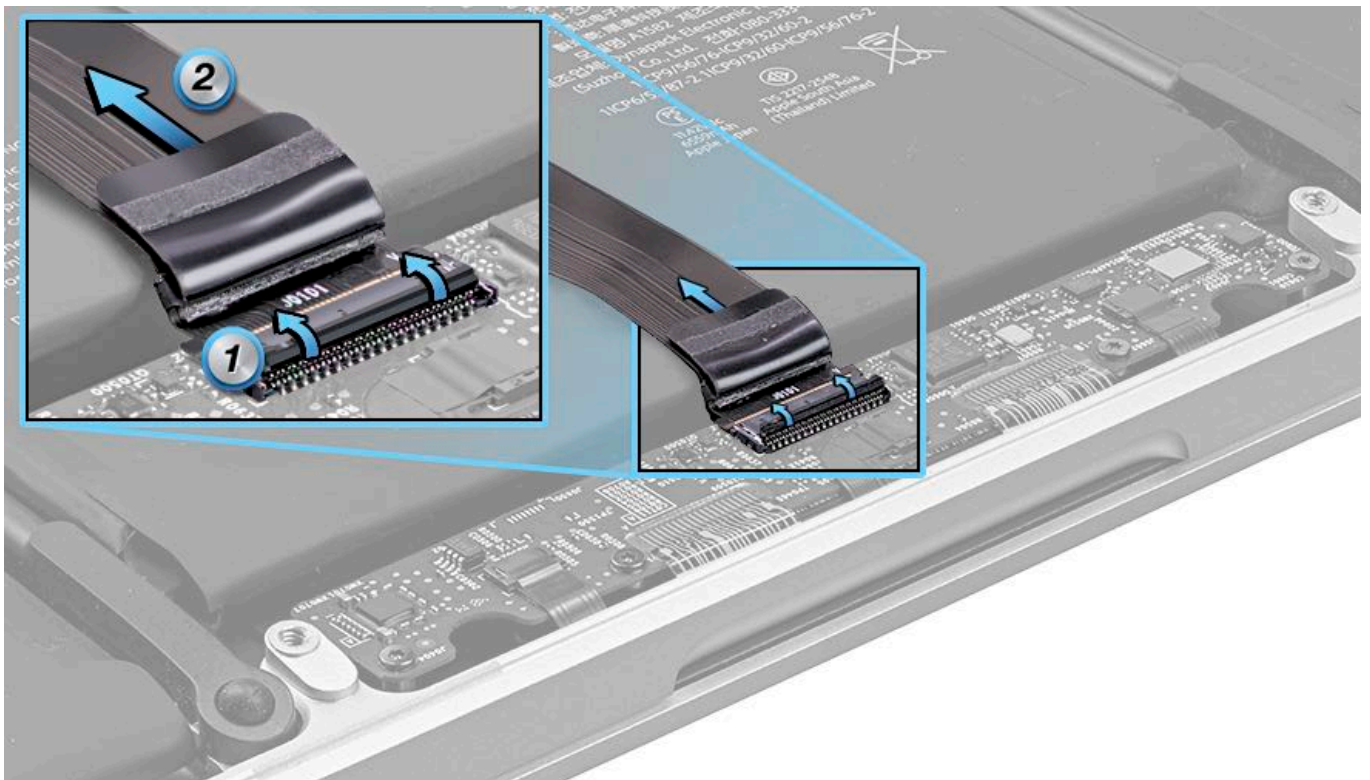


## Steps For Removal

1. Using a black stick, pry up the the trackpad flex cable connector (1) from the logic board, then gently peel the cable (2) off the battery, toward the other end of the cable.



2. With a black stick, flip the locking lever (1) up and gently pull the Mylar tab (2) to disconnect the trackpad flex cable from the connector. **Note:** Press the locking lever down (closed position) to avoid damaging to the connector.



## Steps For Reassembly

1. Reassemble in reverse order of removal steps.

2. **MacBook Pro (Retina, 13-inch, Early 2015) only:** Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).



# Logic Board

## First Steps

**Important:** This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT202594: Exams for Service Technicians](#).

For video instruction, refer to article [SV217: Logic Board Replacement Video](#).

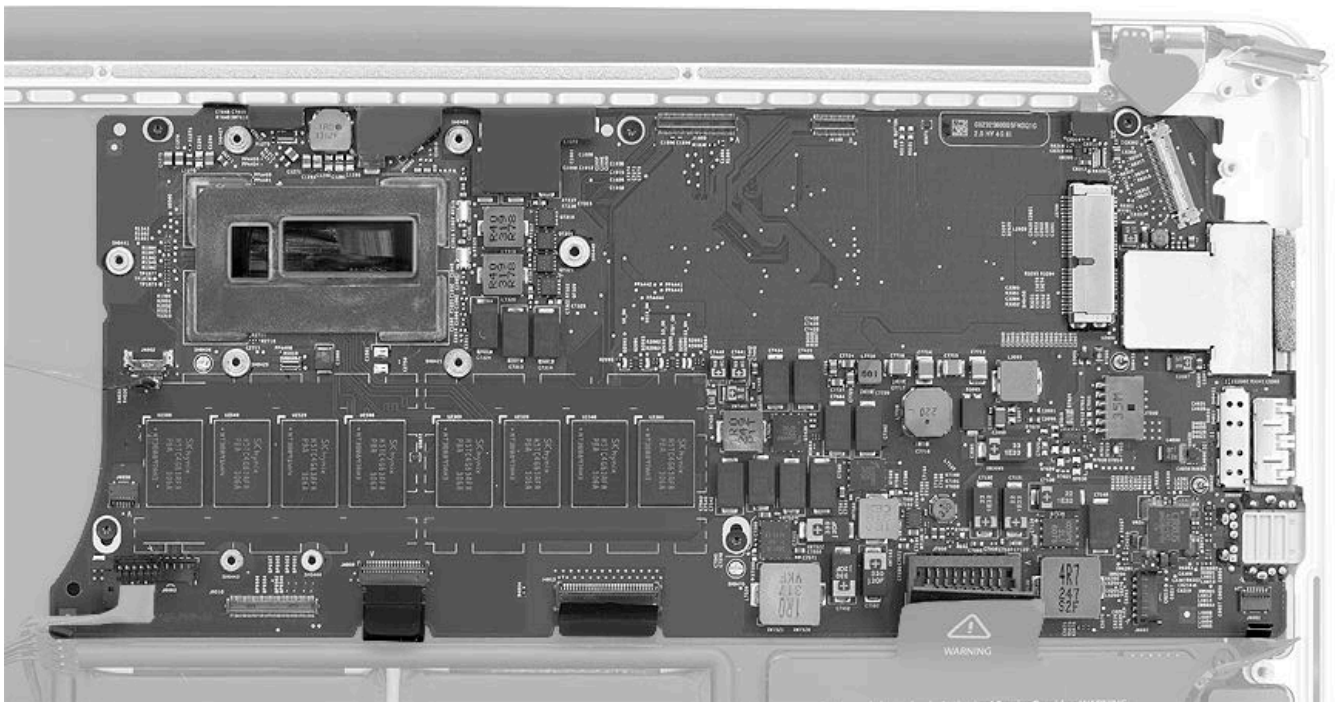
Remove:

- [Bottom case](#)
- [I/O flex cable](#)
- [Flash storage](#)
- [MagSafe 2 board](#)
- [Heat sink](#)
- [Fan](#)

**Important:**

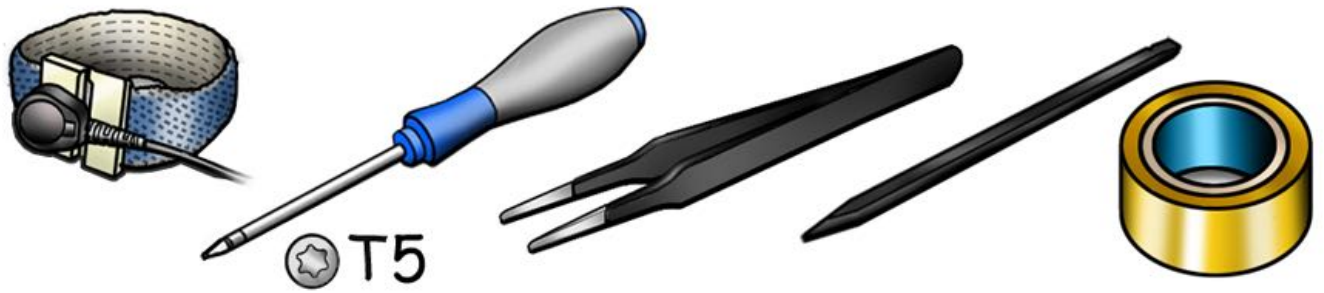
- Always wear an ESD wrist strap and take precautions to avoid ESD.
- Always [attach the battery cover and disconnect the battery](#) immediately after removing the bottom case.

**Note:** The MacBook Pro (Retina, 13-inch, Mid 2014) logic board is shown in this procedure, but the procedure is the same for the Late 2013 and Early 2015 models.



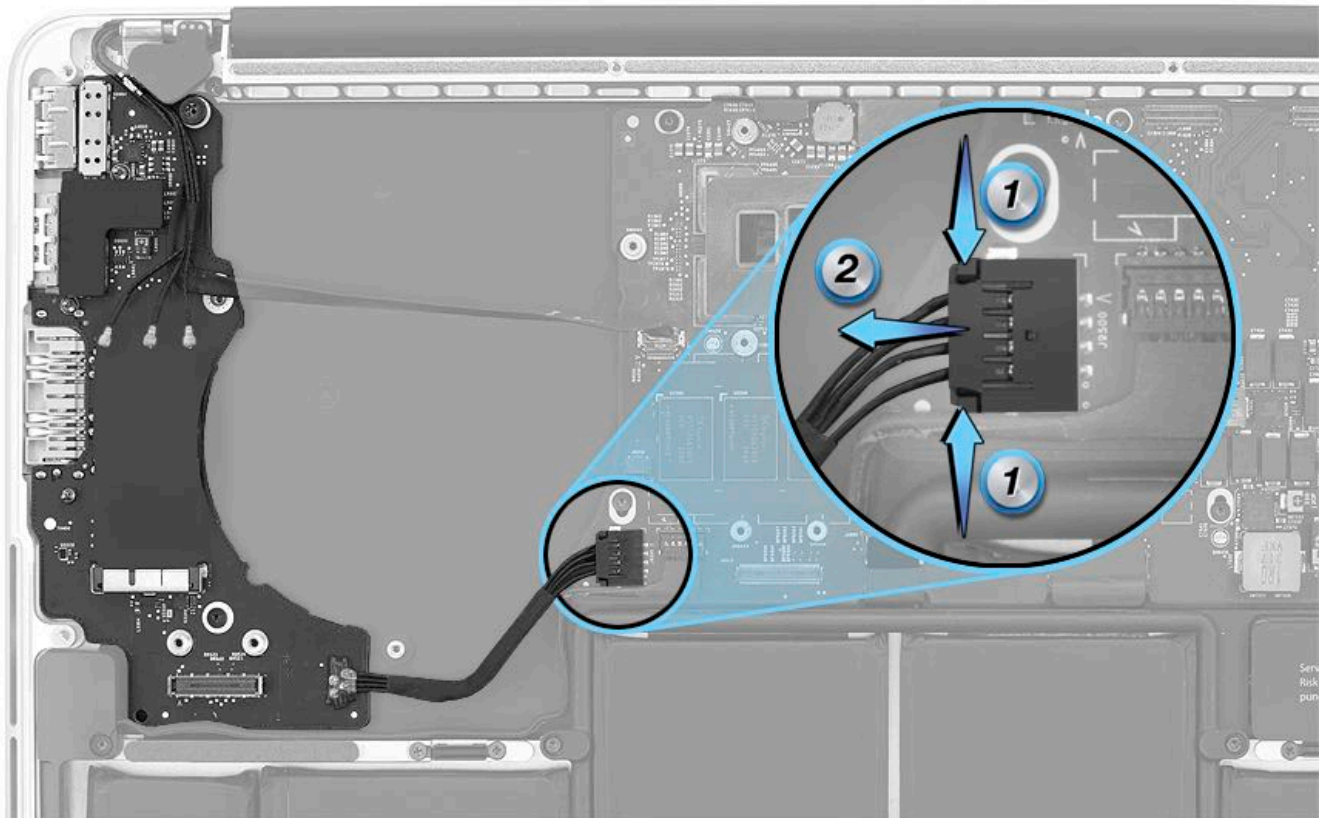
## Tools

- ESD wrist strap
- Torx T5 screwdriver (magnetized)
- ESD-safe plastic or nylon tweezers
- Black stick
- Kapton tape (optional)



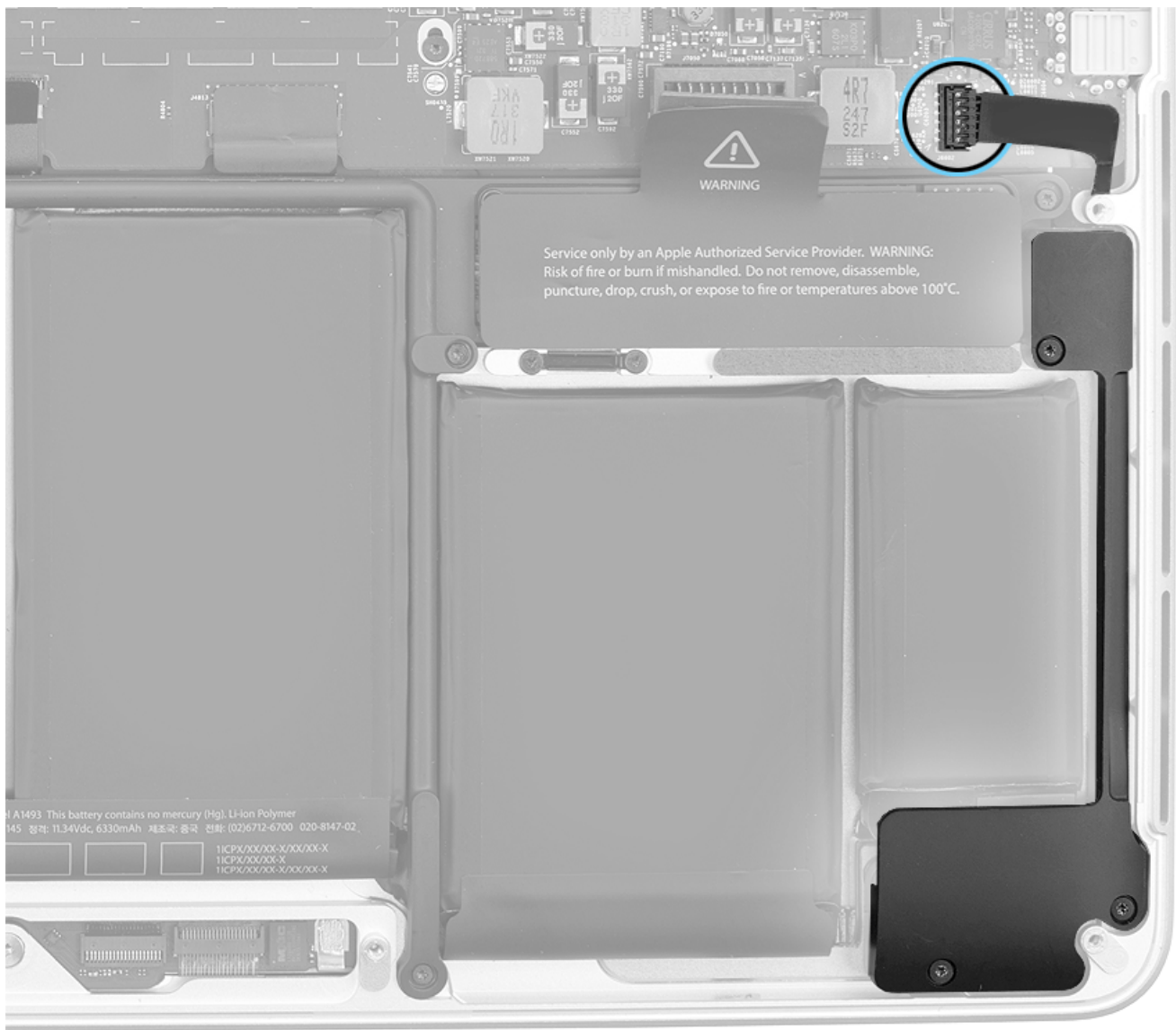
## Steps For Removal

1. Disconnect the I/O cable.



2. Disconnect the left speaker cable. The connector is a vertical insert or JST-type connector. **Note:** The underside of the cable (near the JST connector) adheres to the logic board with adhesive. Use the flat end of a black stick to pry the cable and connector from the logic board.

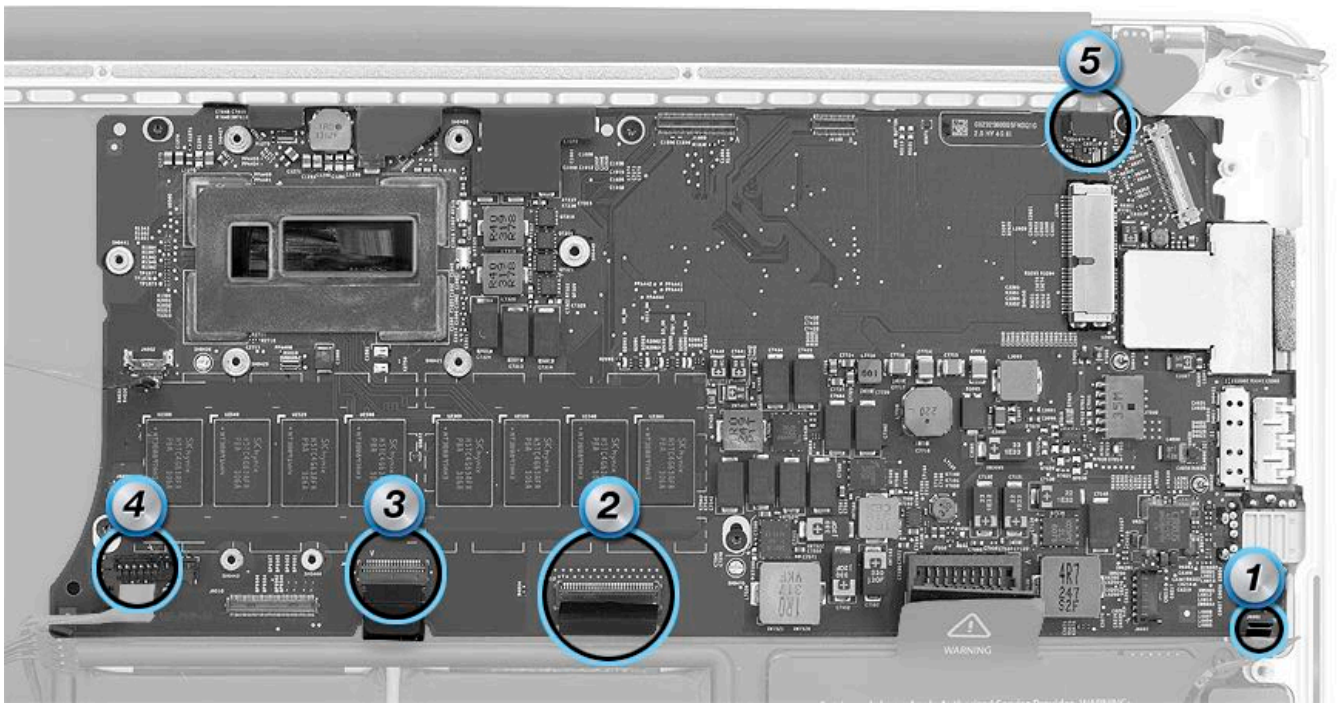




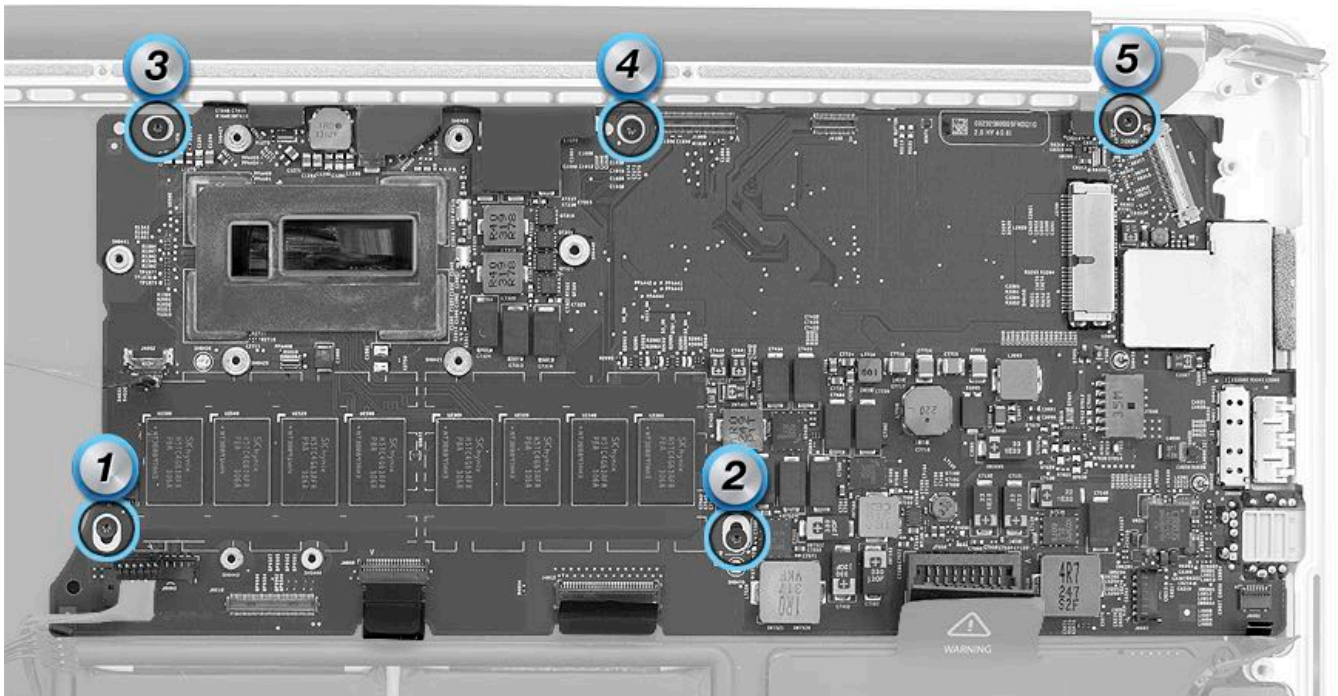
3. Disconnect five connectors in the order shown.

- Connectors 1, 2, and 3 are locking lever-type connectors. **Note:** Connector #3 on MacBook Pro (Retina, 13-inch, Early 2015) is a press fit-type connector, like connector #5.
- Connector 4 is a vertical insert or JST-type connector.
- Connector 5 is a solid platform flex or press fit-type connector.

**MacBook Pro (Retina, 13-inch, Late 2013 and Mid 2014) logic board**



4. Remove five identical T5 screws (923-0235).

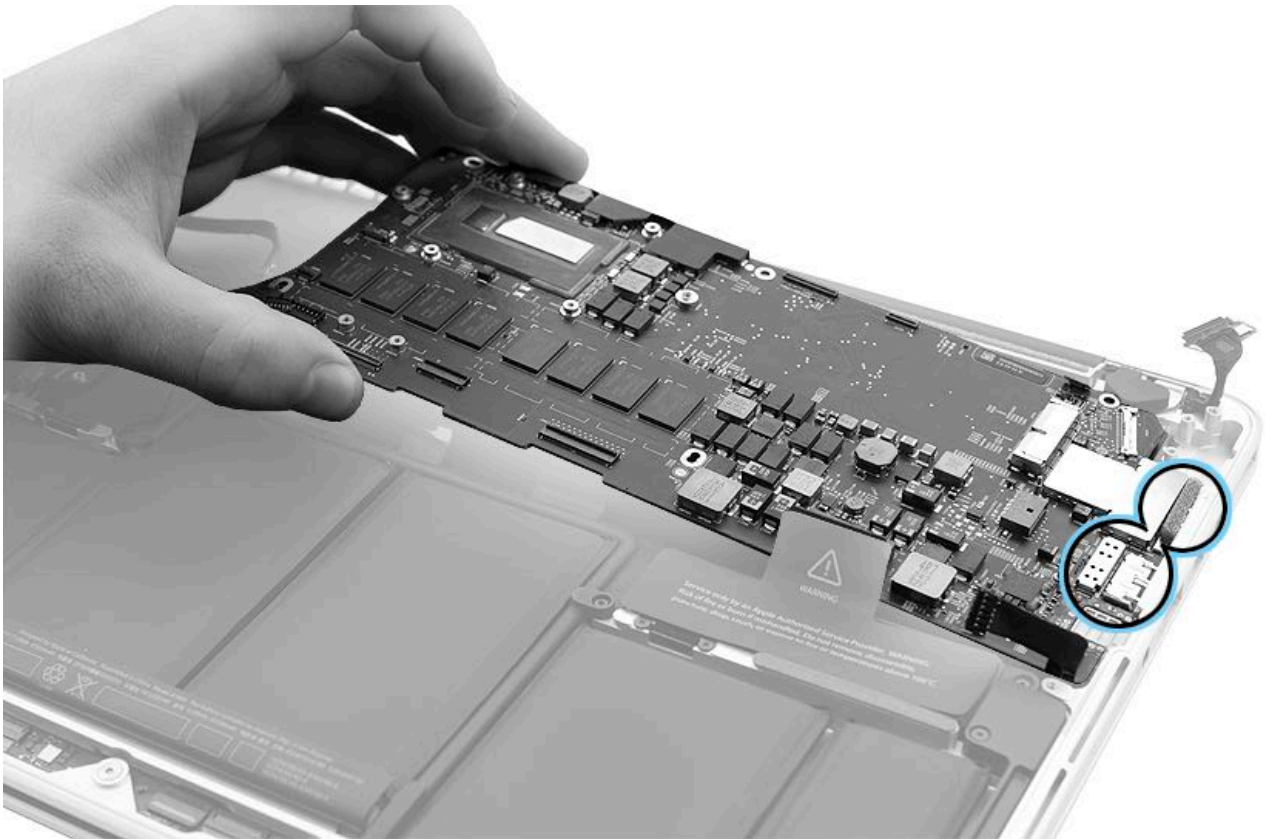


5. Starting at the end of the logic board closest to the I/O board, tilt up the logic board at a **15-degree angle** to carefully clear it from the connectors. **The angle of tilt is important to prevent connector damage.** You may need to loosen the top edge of the battery cover.

6. Rock the board slowly to free it from the ports. Follow safe handling:

- Hold the board by the edges.
- Keep the board tilted at a 15-degree angle.
- Do not touch the gold pads on the logic board.
- Do not touch circuitry.

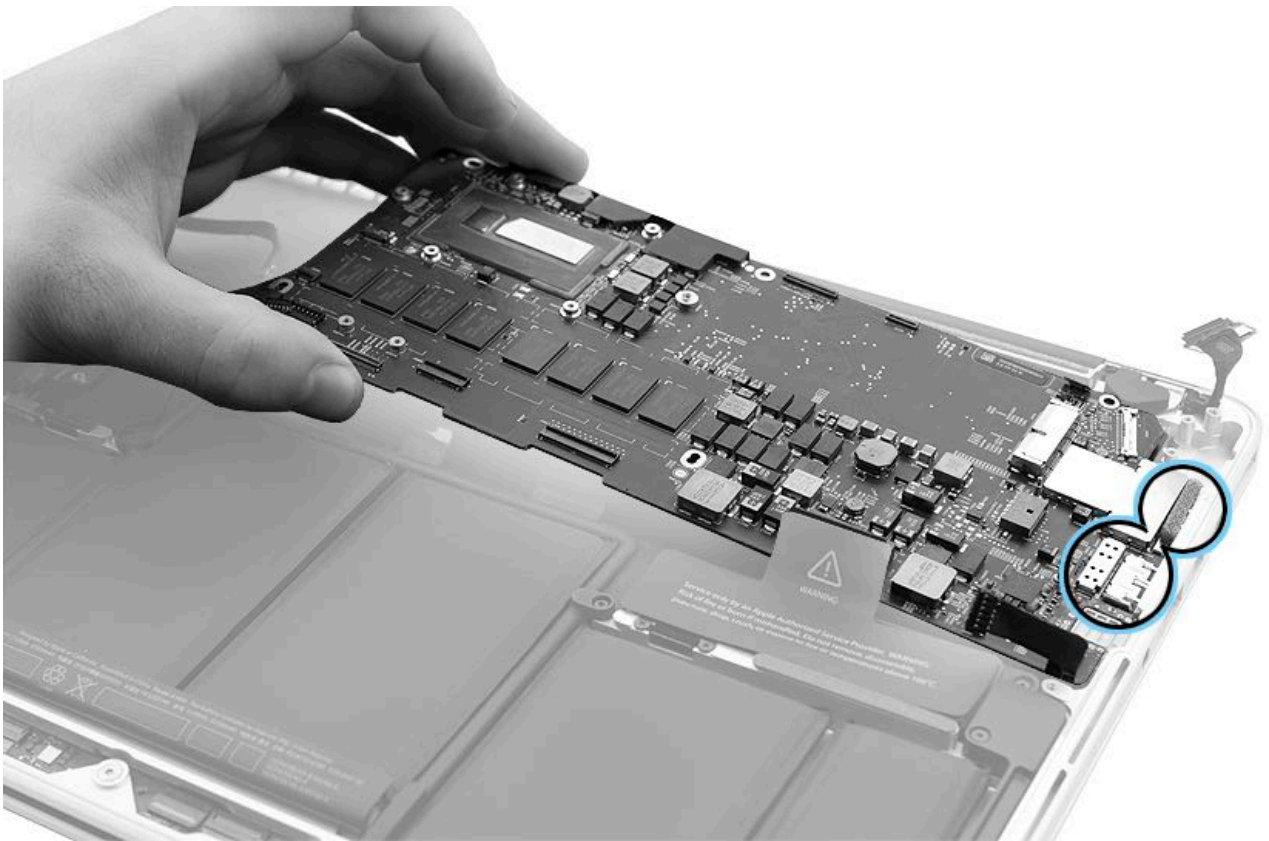
**Tip:** Use strips of Kapton tape to set cables out of the way after removing the logic board from the top case. Count the number of tape strips that you use. Taping the cables can help prevent the cables from becoming trapped underneath the logic board during reassembly.



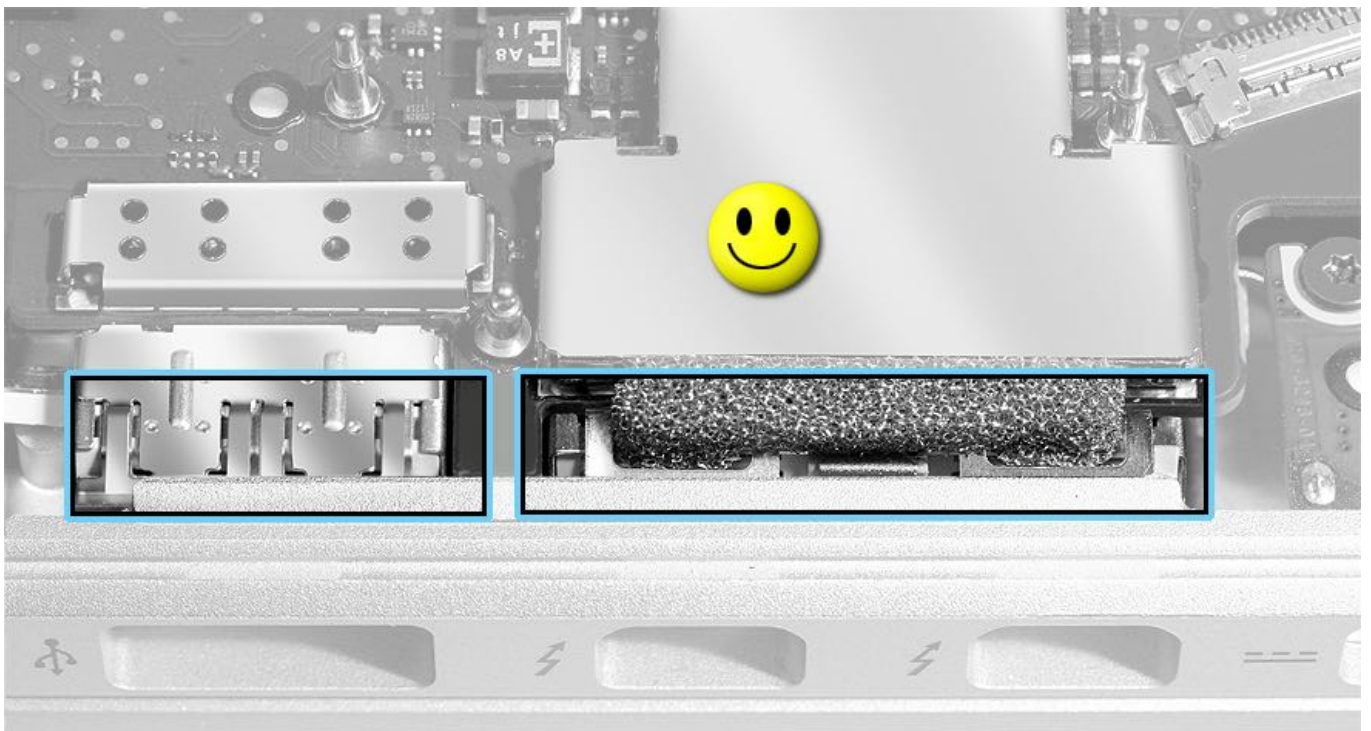
**Important:**

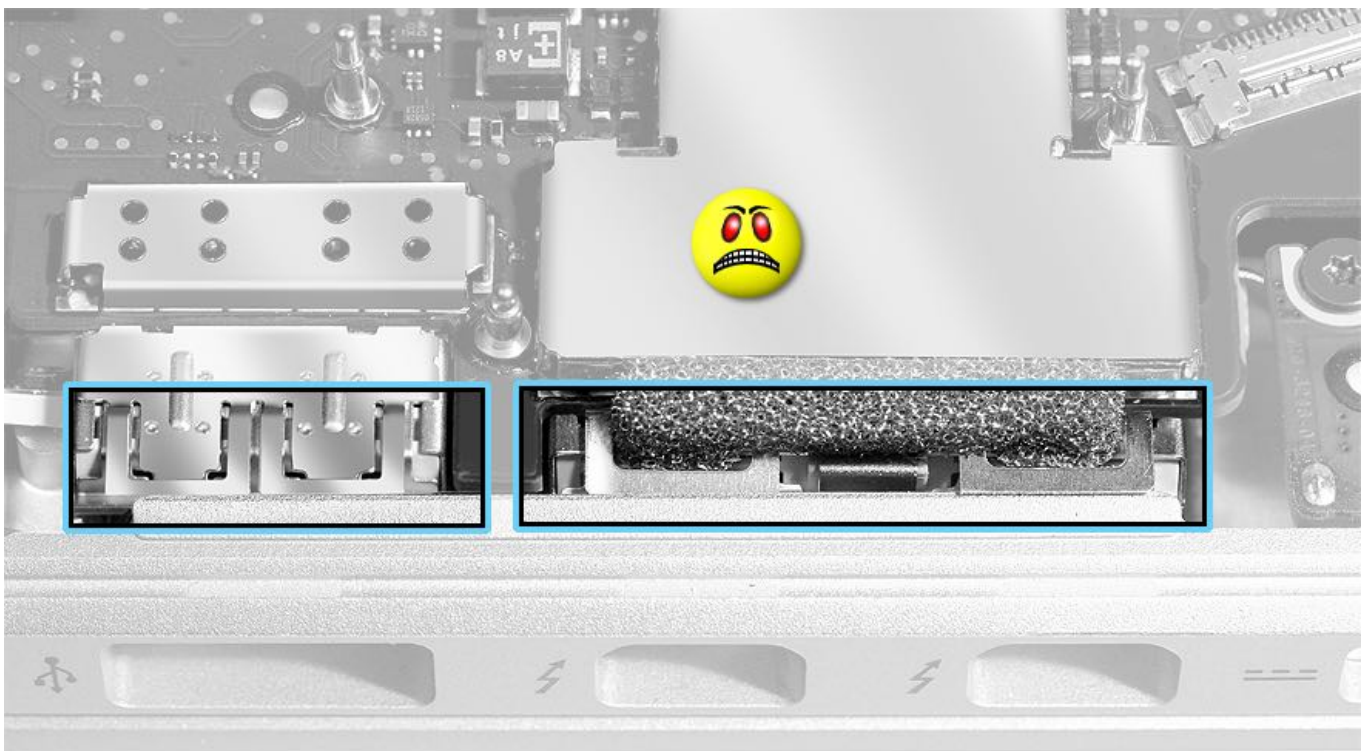
1. Tilt the logic board into the top case at a **15-degree angle**, using caution at the ports to prevent damage to the EMI ground tabs. **Note:** The angle of tilt is important to prevent connector damage.





Note the metal EMI ground tabs on the USB 3 and Thunderbolt ports. The C-shaped tabs must tuck **under** the lip of the top case. Press the tabs with a fingernail, if necessary, to tuck them under the lip.

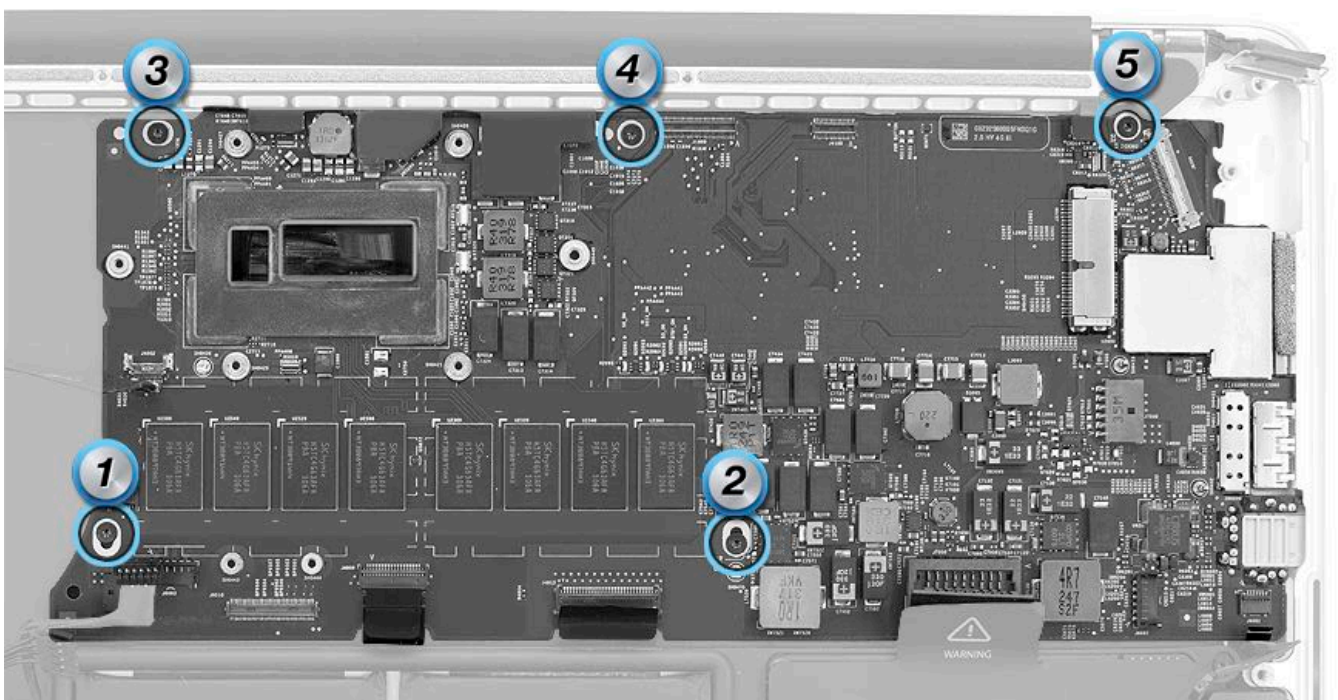




2. Check that no cables are pinched underneath the board.

3. Install the five logic board screws halfway first, while pushing the board against the top case ports to ensure a secure fit. Adjust the board seating if necessary, then tighten screws.

Five T5 screws (923-0235)



**Important:** If Kapton tape was used to set the cables out of the way, retrieve the tape strips after connecting the cables. Verify that the number of tape strips removed equals the number of tape strips used. Ensure that all the Kapton tape strips



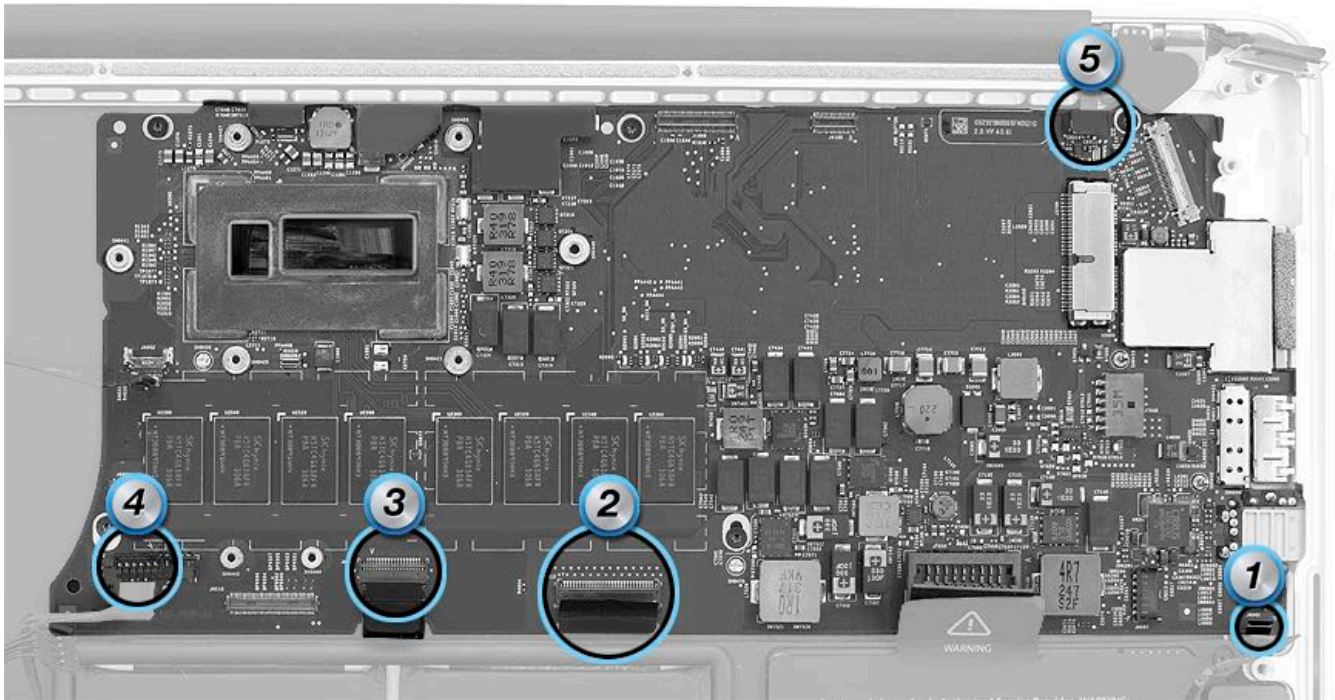
are removed from the computer.

4. Connect all five connectors in reverse order from that shown, starting with 5 and ending with 1. **Note:** Connector #3 on MacBook Pro (Retina, 13-inch, Early 2015) is a press fit-type connector, like connector #5.

**Important:** Locking lever connectors (1, 2, and 3 on MacBook Pro (Retina, 13-inch, Late 2013 and Mid 2014) take precision and patience to connect. **Tip:** To connect the locking levers to the logic board, attach a piece of Kapton tape at the end of the connector to give yourself a little more leverage when trying to insert the cable into the connector. Make sure to use Kapton tape due to ESD concerns.

5. Reconnect the left speaker cable.

6. Reconnect the I/O cable.



**For MacBook Pro (Retina, 13-inch, Early 2015) only:** Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).

**For all models:** If you have installed a replacement logic board, use Blank Board Serializer (BBS) to set the computer's serial number after the computer has been reassembled. BBS can be run from AST 1 or AST 2, or as a stand-alone, USB-based version found in article [SD63: Blank Board Serializer](#).

- For more information about AST and supported Mac models, see article [OP476: Latest Apple Service Toolkit download links and documentation](#).
- **Important:** When using BBS in AST 1 or AST 2, ensure that the unit under test (UUT) and the AST server are connected to the same network, and that the AST server has the latest software version installed.

### Returning Original Board to Apple

#### Caution:

- Avoid damage to the board by not touching the ports and always holding the board by the edges.
  - While the board is out of the top case, do not install screws. Doing so could cause cracks.
1. Install port covers over the Thunderbolt and USB 3 ports. Make sure the C-shaped EMI ground tabs tuck inside the port covers.  
**Caution:** Port covers (076-1426) offer protection during shipment and handling. A returned logic board without port covers is easily damaged and will not be accepted for return.
  2. If a foam pad prevents full installation of the port cover, use Kapton tape to secure the cover.

# Display Assembly and End Caps

## First Steps

**Important:** This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT202594: Exams for Service Technicians](#).

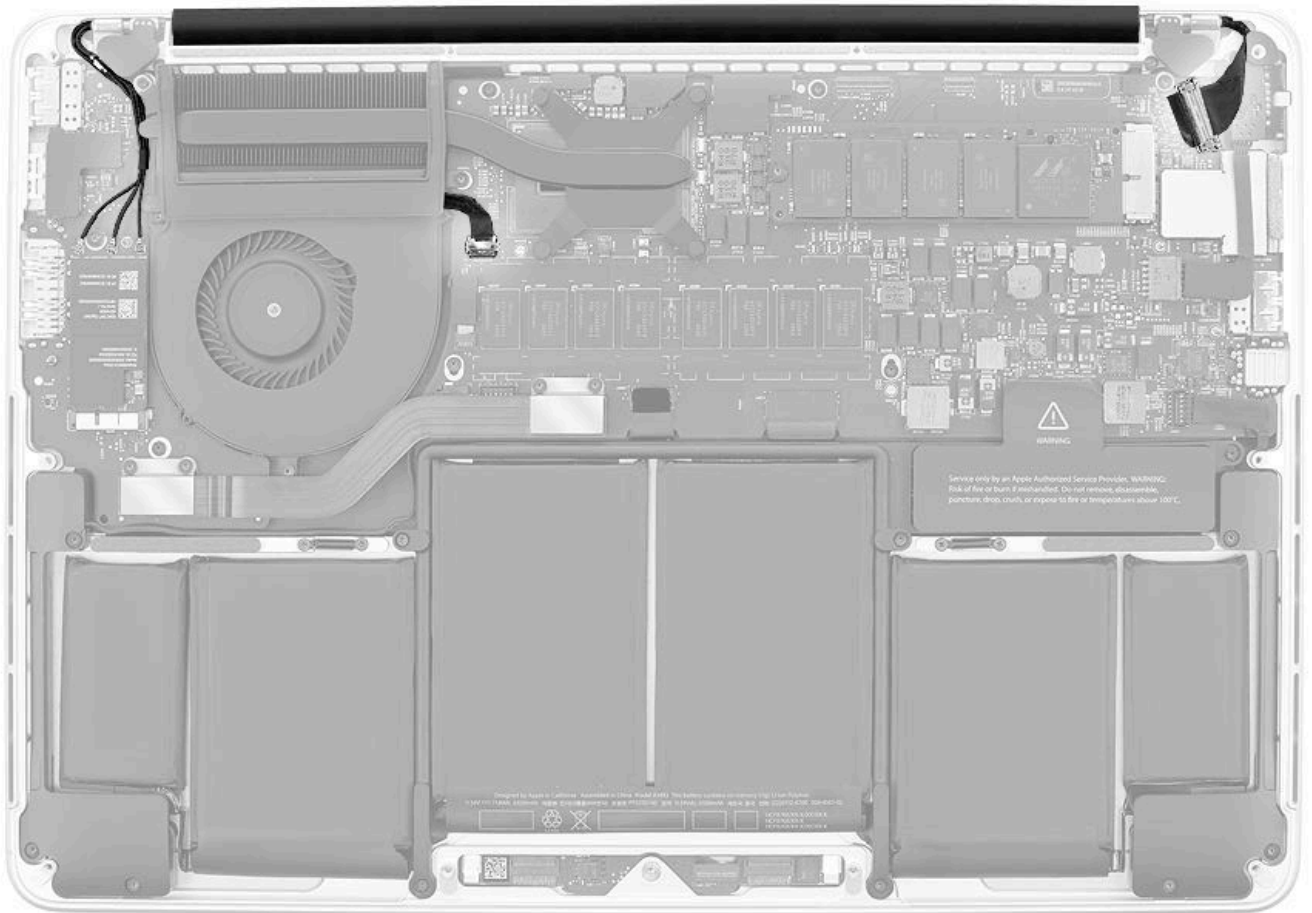
Remove:

- [Bottom Case](#)

## IMPORTANT:

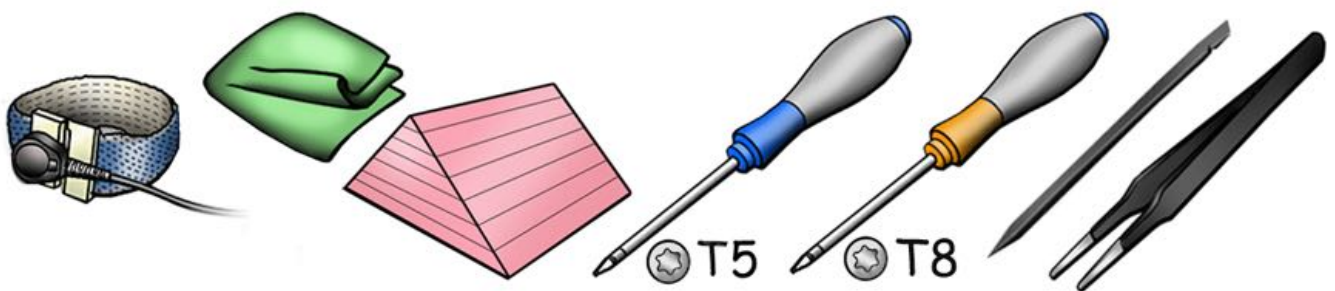
- Always wear ESD wrist strap and take precautions to avoid ESD.
- Always [attach battery cover and disconnect the battery](#) immediately after removing bottom case.





## Tools

- ESD wrist strap
- Clean, soft, lint-free cloth
- Foam wedge service fixture
- Torx T5 screwdriver, magnetized
- Torx T8 screwdriver, magnetized
- Black stick
- ESD-safe flat-head tweezers



## Steps For Removal

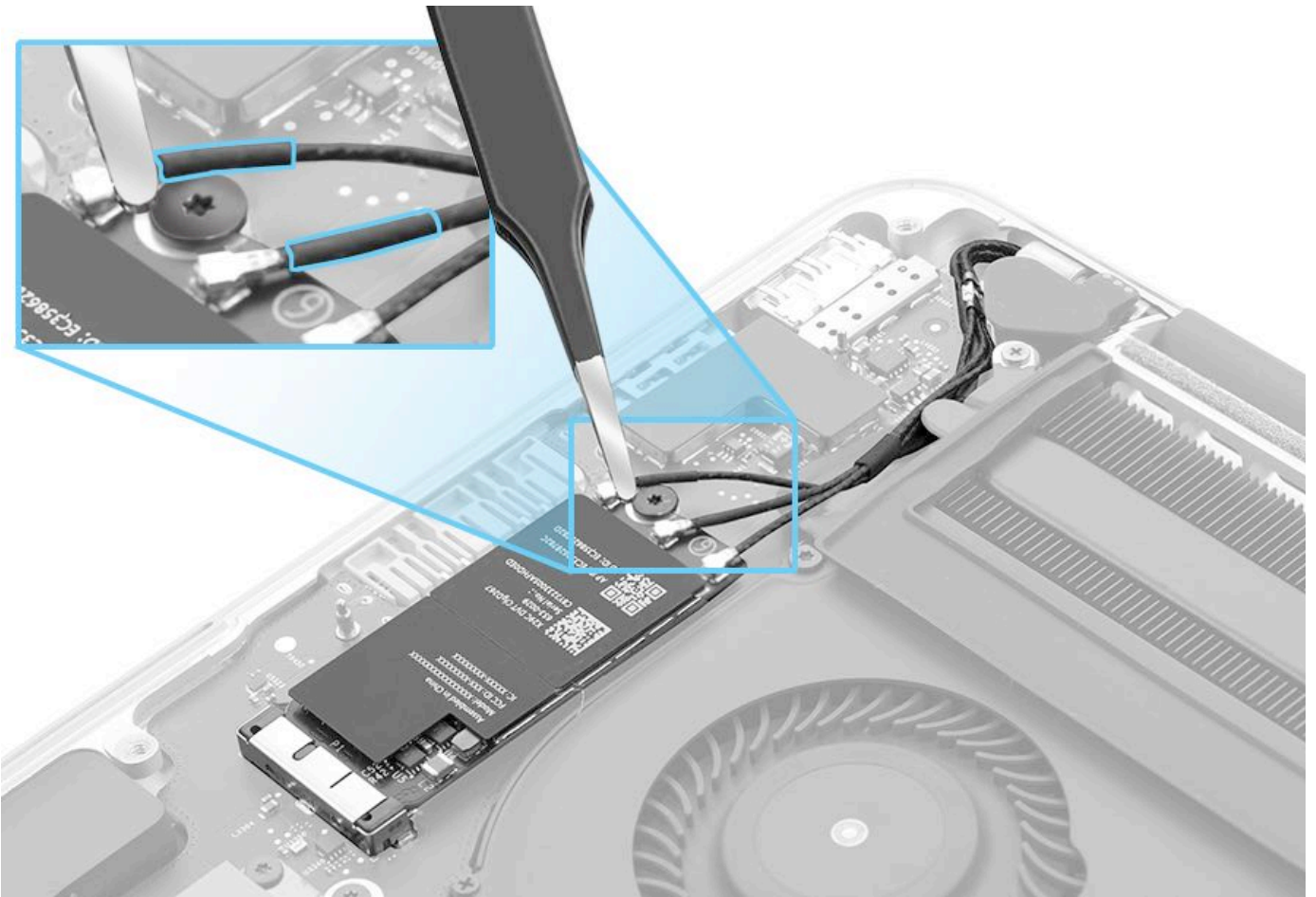
1. Use black stick to remove rubber gasket (1).

**Note:** The rubber gasket (1) is not present on the MacBook Pro (13-inch, Early 2015) model.

2. Use black stick to flip the locking bar (2) and disconnect embedded DisplayPort (eDP) cable from logic board.

Using tweezers, carefully grip first cable on metal extension behind connector head (area indicated by circle). Gently pop cable straight up off card. Repeat for other two antenna cables.

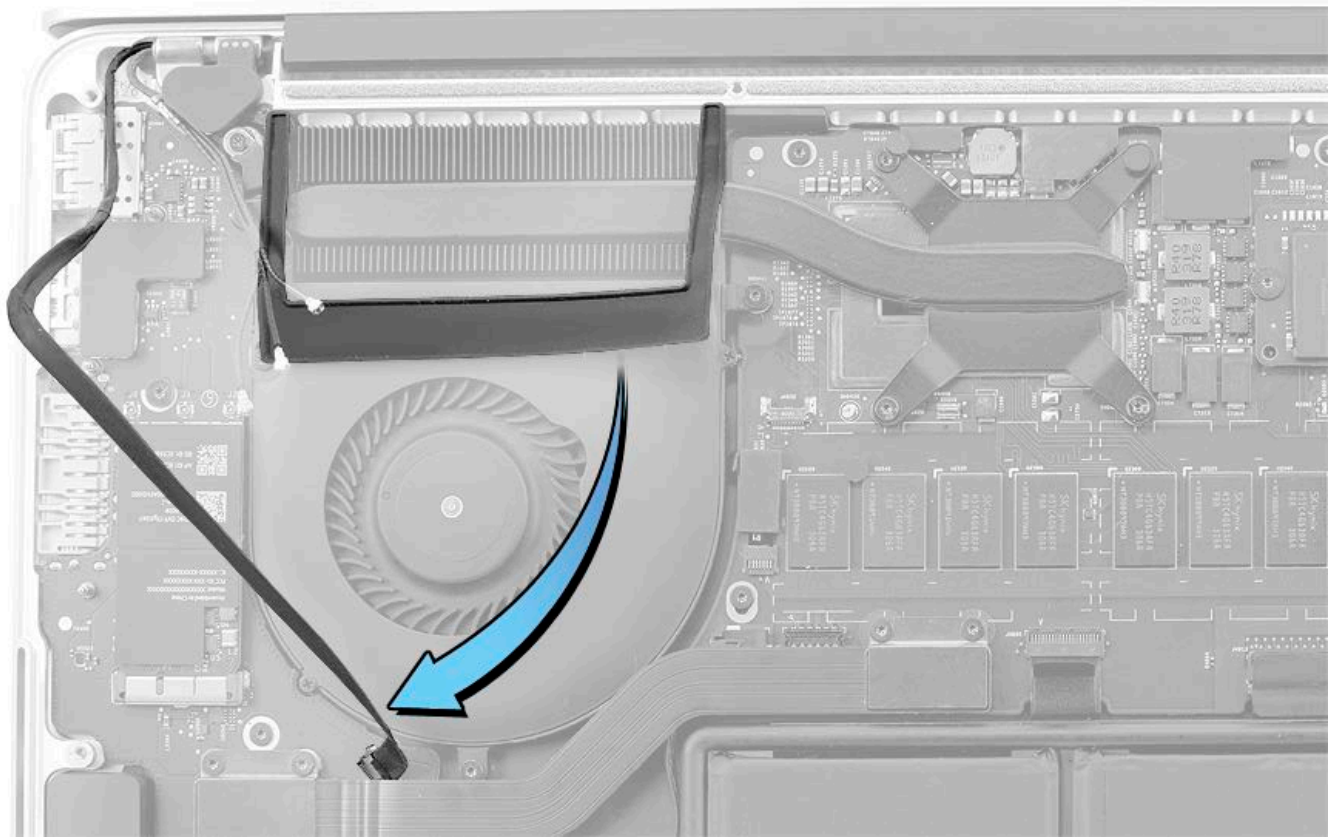




4. Disconnect camera cable. Use a black stick to lift up fan duct just enough to slide camera cable out from underneath the fan duct.

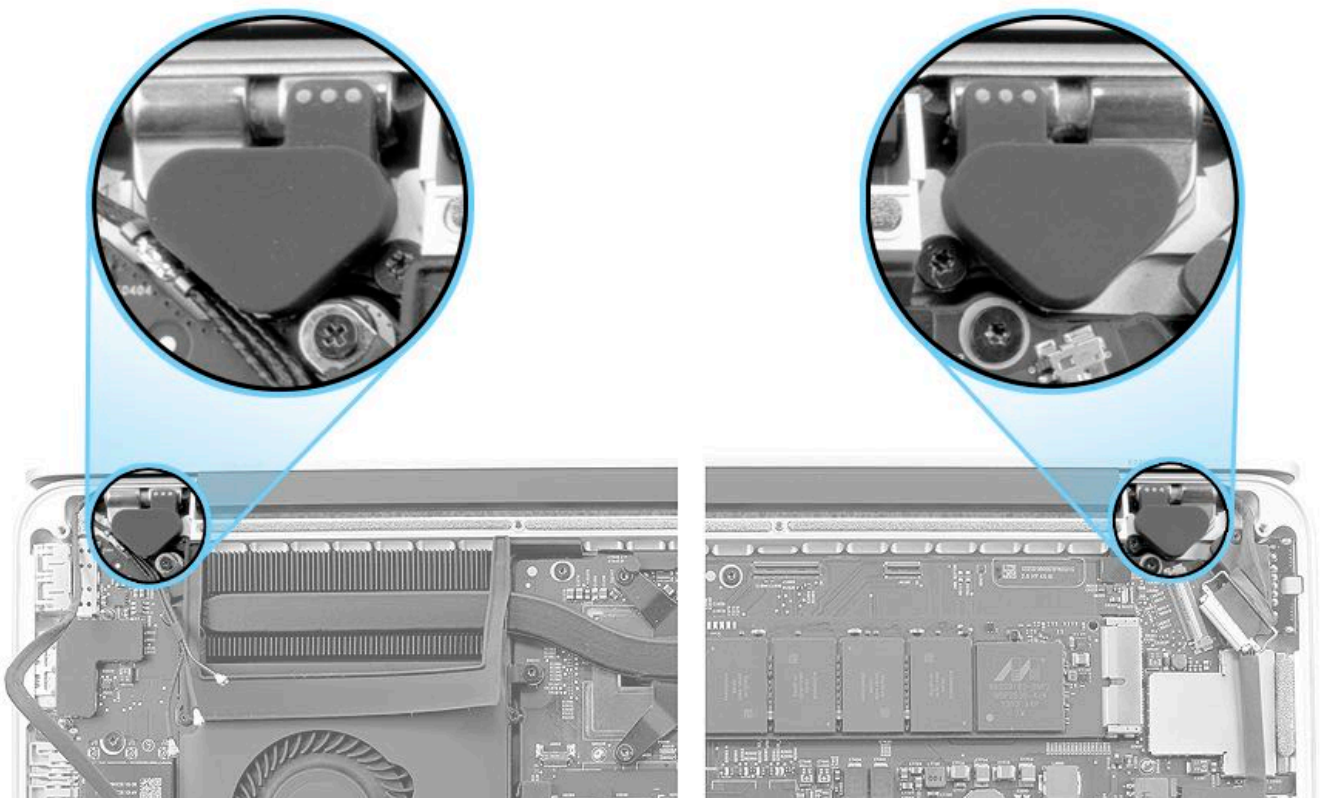




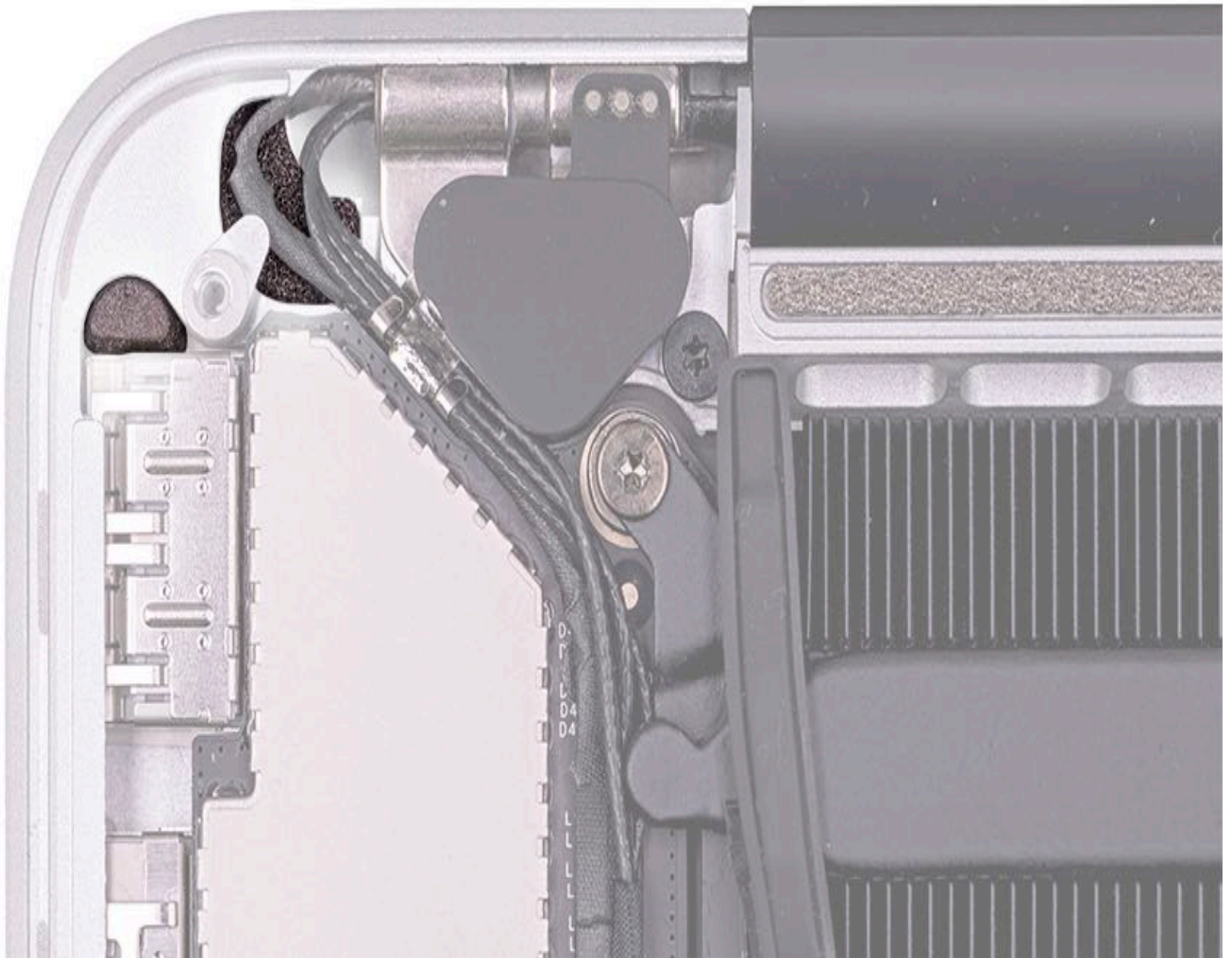


5. Use black stick to remove two clutch screw covers.

**Reassembly Note:** Replace rubber clutch covers with new ones each time they are removed. The adhesive is for one-time use.



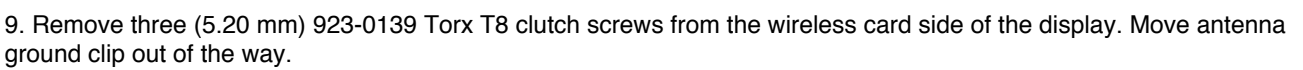
6. Remove one (3.07 mm) Torx T5 (1) mounting screw on right display end cap, then lift the metal end cap (2) out of the top case. Repeat for left end cap. **Note:** Right and left end caps and their screws are included in service kit 076-1410.



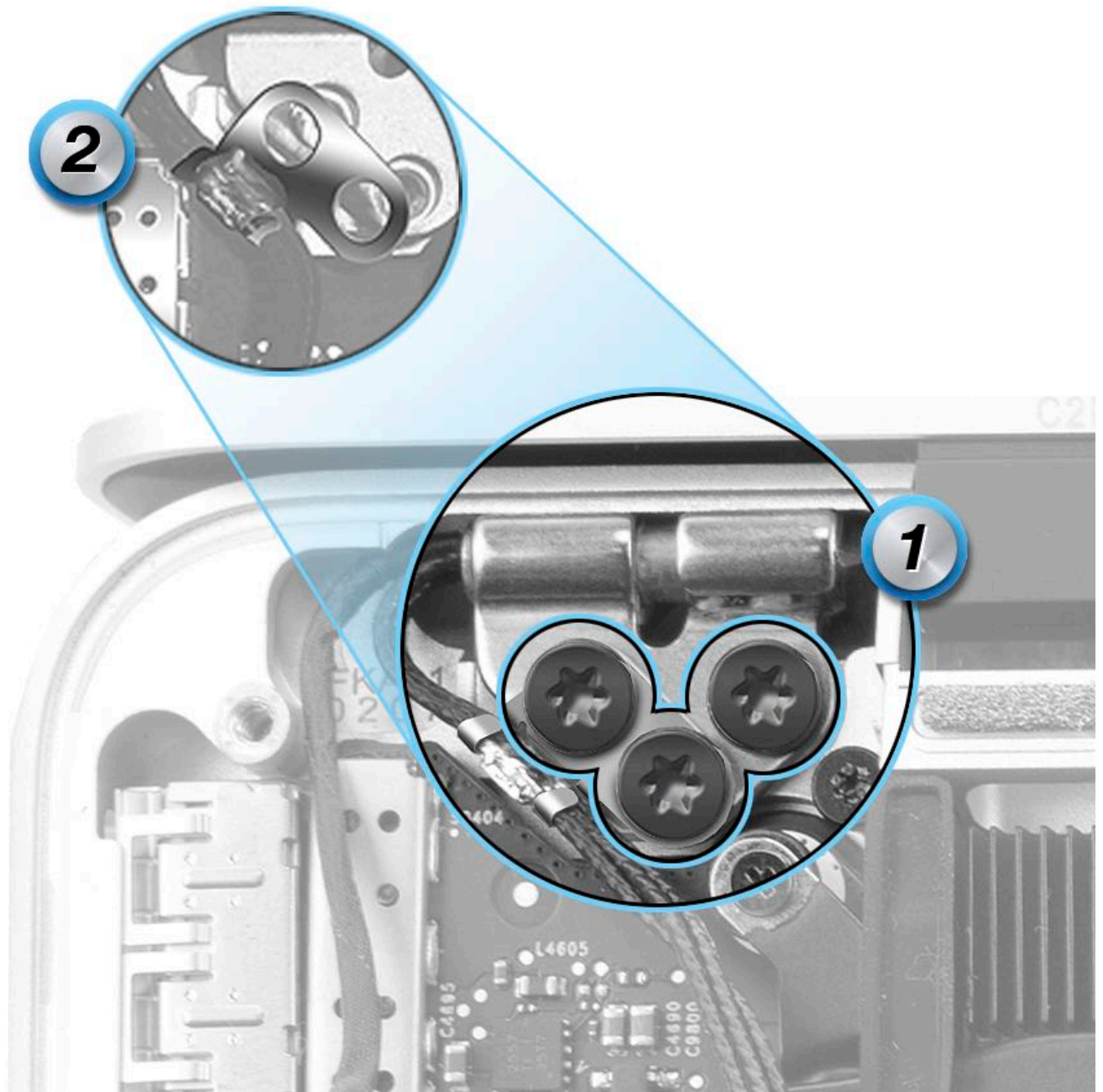
7. Open display to 90 degrees and place computer on foam wedge service fixture.

8. Remove three (5.20 mm) 923-0139 Torx T8 clutch screws from the eDP cable side of the display.









10. Separate display assembly from top case.

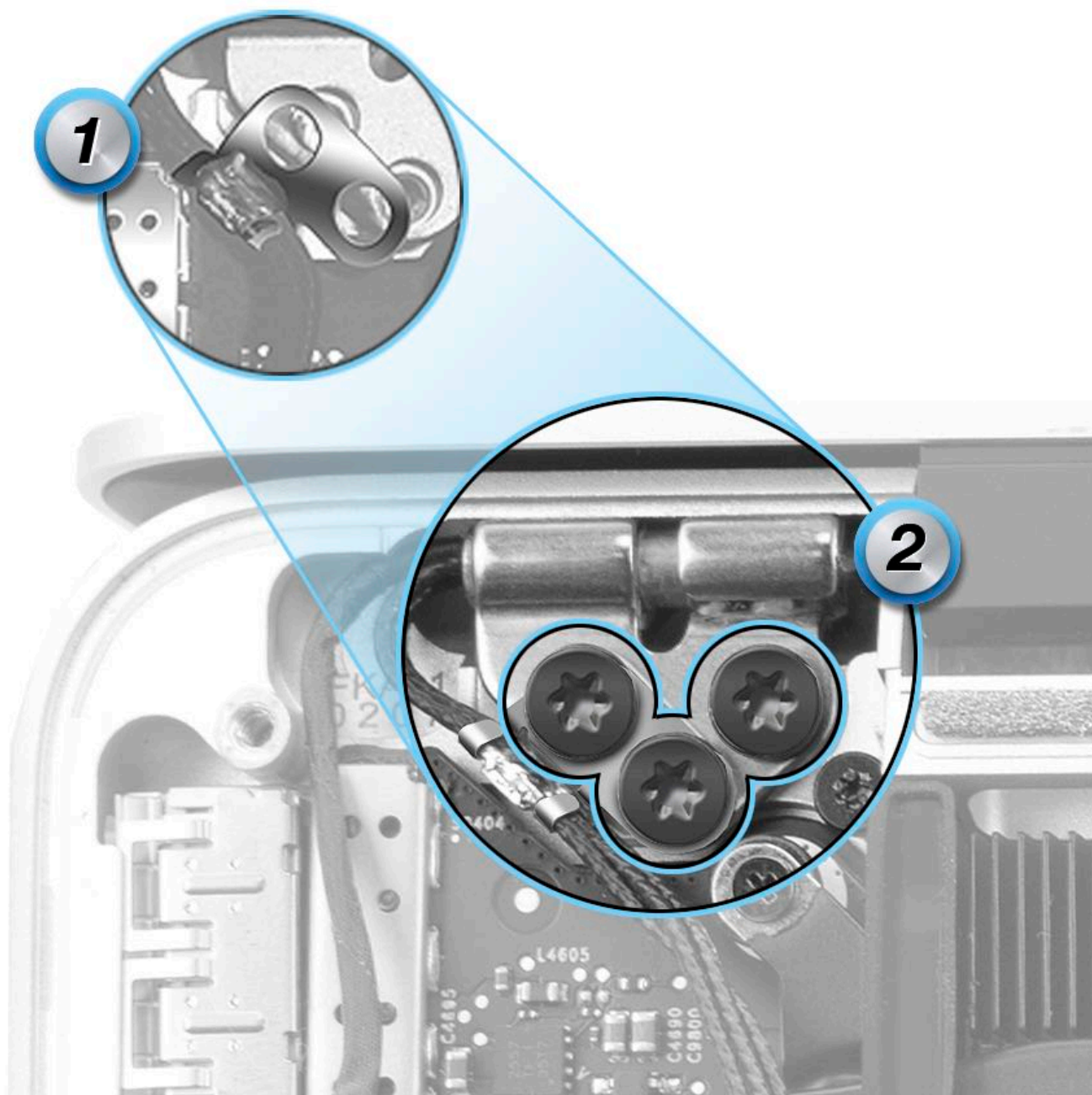
### Steps For Reassembly

**Note:** Extra clutch screw covers are included with replacement display assembly and are also available as service parts: 923-0259 (right cover) and 923-0260 (left cover).

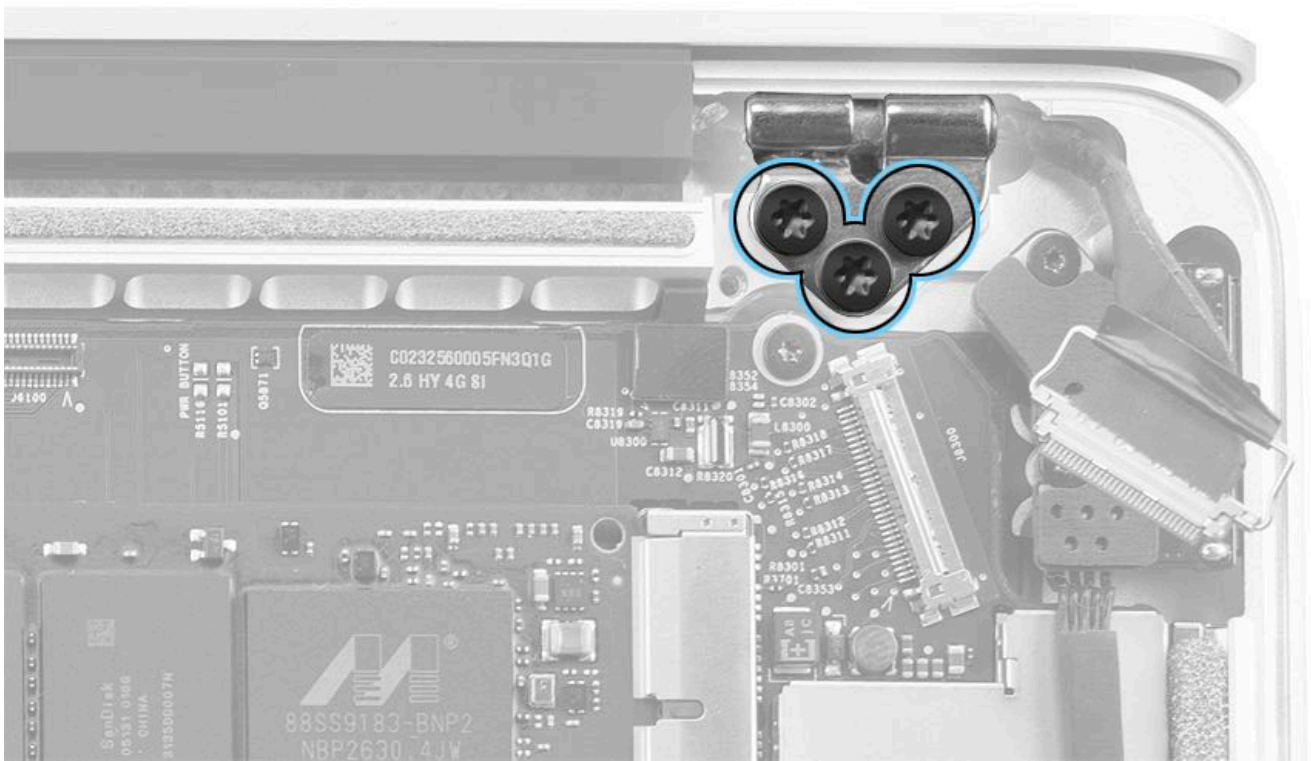
1. When installing six (5.20 mm) 923-0139 clutch screws, do the following:

- Align antenna ground clip over the two screw holes on the clutch nearest the wireless card and loosely install middle screw. Install the middle screw on the opposite side clutch.
- Loosely install left clutch screw on both clutches.
- Loosely install remaining clutch screws at both clutches.



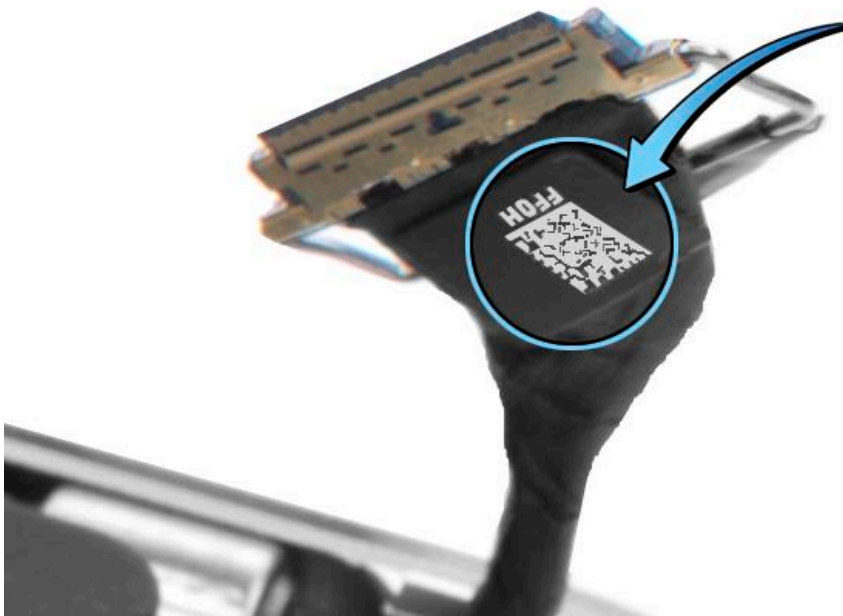






2. Remove the computer from the foam wedge service fixture, close the display, align top case to display, and tighten all six screws.

**Note:** If you are replacing the display with a new display, scan and record the 2D barcode under the eDP cable.



3. Continue reassembly in reverse order of removal steps.

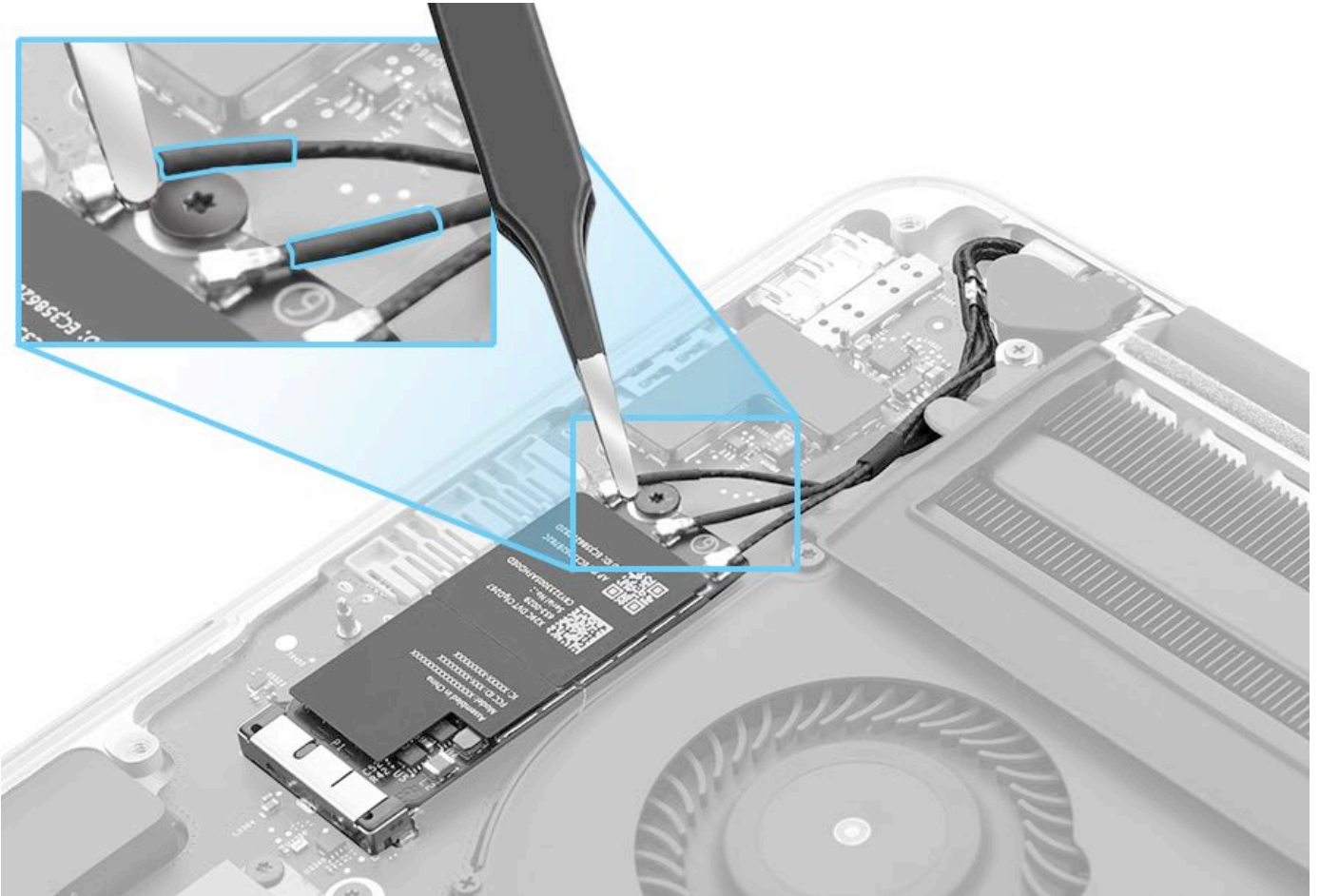
**IMPORTANT:** Make sure wireless card cables are connected in the correct order:

- Short insulation: Cable connects closest to HDMI port
- Long insulation: Cable connects to middle connector
- No insulation: Cable connects closest to fan

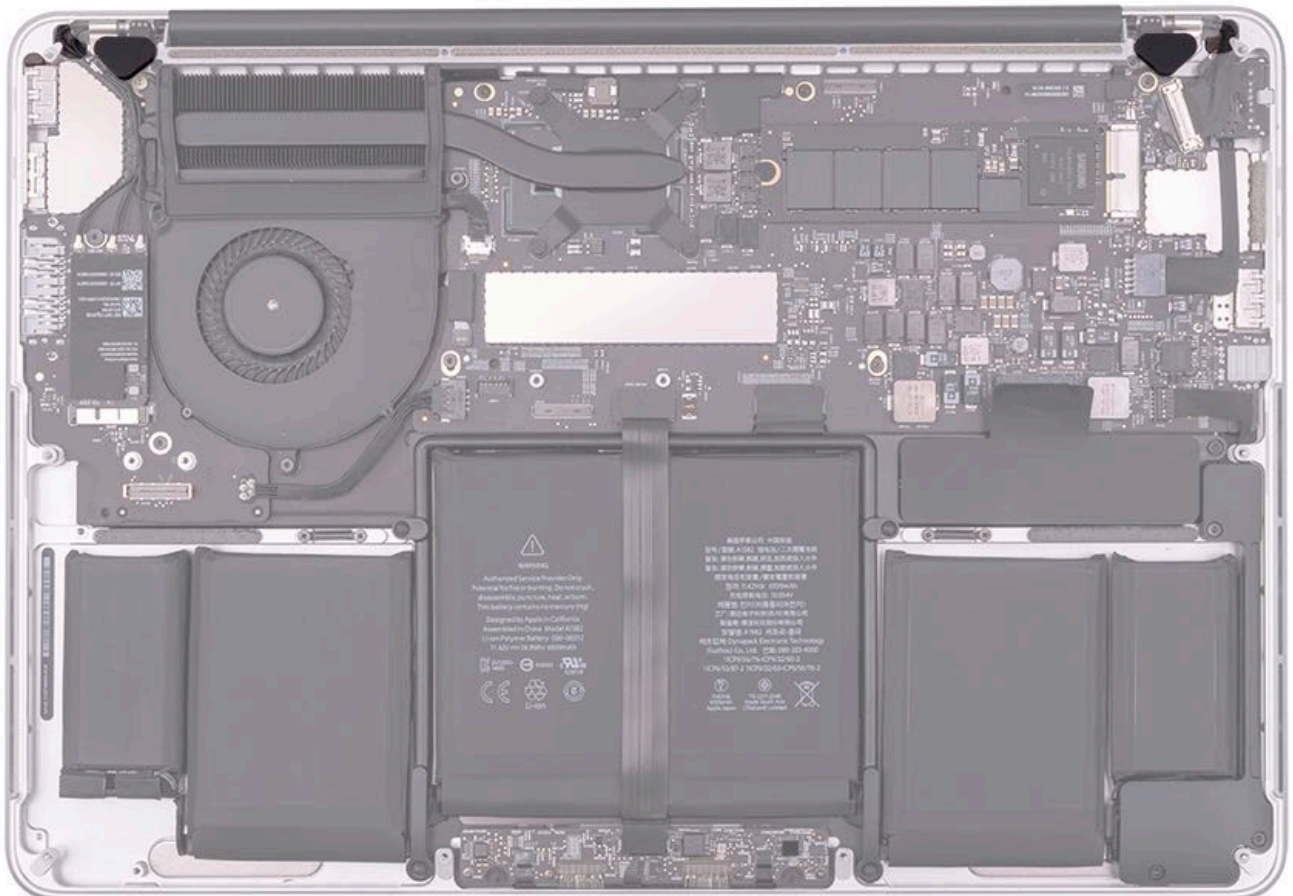
Do not swap cable positions, and make sure cables do not overlap screws.

Use tweezers when reconnecting wireless card cables. Position antenna cable head over connector until you feel it seat with the connector. Then carefully press straight down with a finger until head snaps into place. Repeat for the remaining two antenna cables.

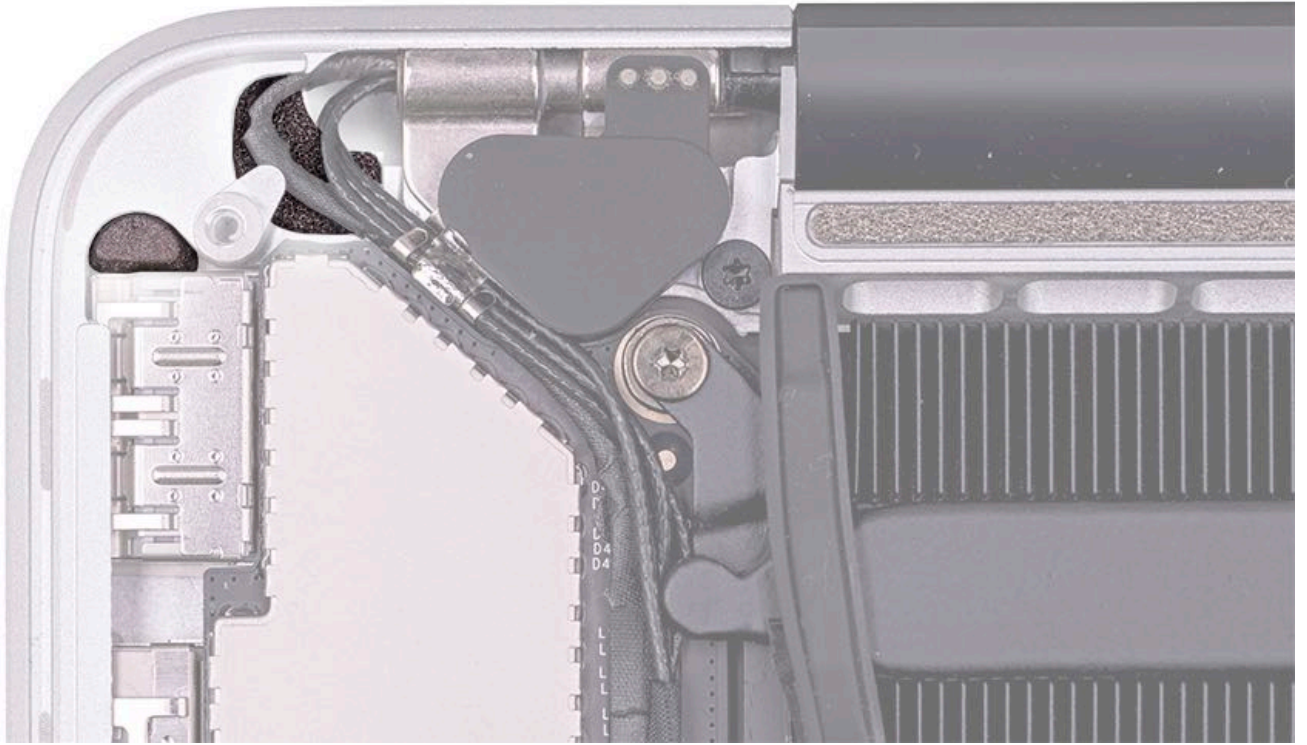
**Caution:** Using too much force to reseat antenna cables can distort connector or connector rim.



4. Make sure the clutch screw covers and foam gaskets are in place in the top cover before replacing the bottom case.



**Note:** MacBook Pro (Retina, 13-inch, Early 2015) has two foam gaskets in the top left corner.



5. **MacBook Pro (Retina, 13-inch, Early 2015) only:** Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).



# Top Case Assembly with Battery

## First Steps

**Important:** This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT202594: Exams for Service Technicians](#).

For video instruction, refer to article [SV216: Top Case Replacement Video](#).

Remove:

- [Bottom case](#)
- [I/O flex cable](#)
- [Right and left speakers](#)
- [MagSafe 2 board](#)
- [Heat sink](#)
- [Fan](#)
- [I/O board](#)
- [Logic board](#)
- [Display assembly](#)

**Important:**

- Always wear an ESD wrist strap and take precautions to avoid ESD.
- Always [attach the battery cover and disconnect the battery](#) immediately after removing the bottom case.



## Tools

None required.

## Steps For Removal

With the first steps completed, the top case (with battery, keyboard, microphone, and trackpad) is the only remaining component.

The top case assembly service part includes the following parts:

- battery
- keyboard
- microphone
- trackpad
- trackpad flex cable (included only with Early 2015 model)
- removable parts such as screws, flexures, and clutch screw covers

**Caution:** The battery is part of the top case module. Do not attempt to remove the battery from the top case.

**Important:** For information on packaging and returning the top case to Apple, refer to article [TP1058: Battery Handling and Storage](#).



## Steps For Reassembly

1. MacBook Pro (Retina, 13-inch, Late 2013 and Mid 2014): Transfer the foam gaskets and clutch covers if the top case has been replaced, and reassemble in reverse order of removal steps. If you are servicing a MacBook Pro (Retina, 13-inch, Early 2015), follow steps 2-10.
2. **Note:** For MacBook Pro (Retina, 13-inch, Early 2015), the factory preinstalls one end of the trackpad flex cable on replacement top cases. You will need to connect the other end of the flex cable to the logic board connector during reassembly.
3. Follow the reassembly steps in reverse order of the removal steps, but before installing the logic board, **carefully** remove the tape that secures the trackpad flex cable to the top case. Discard the tape.





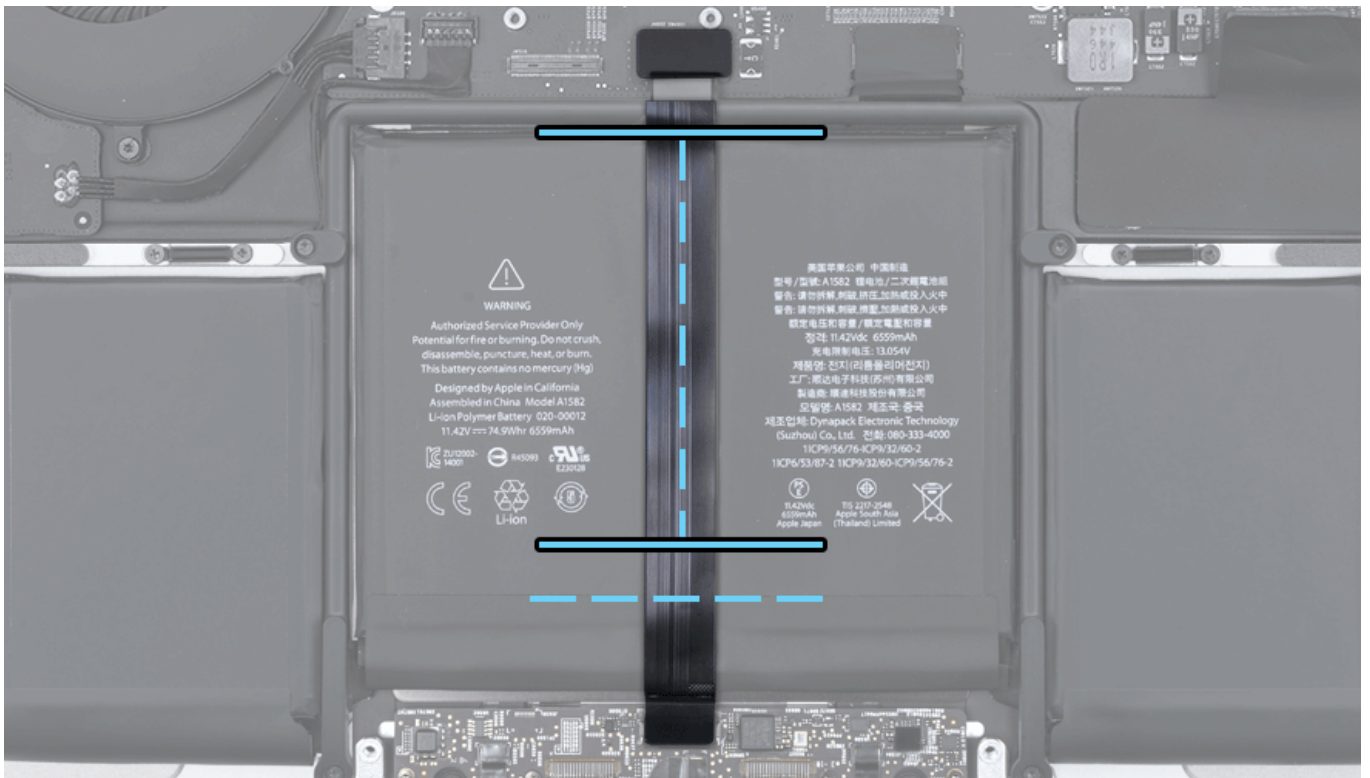
4. Once the logic board is installed, connect the trackpad flex cable to the logic board. **Important:** Ensure that you don't bend the flex cable; multiple bends could degrade cable integrity.



5. Pull the two blue pull-tabs (on the underside of the flex cable) in a downward motion to remove the adhesive backing on the underside of the cable.



6. Secure the cable to the battery. Starting at the top of the cable, apply light pressure with your finger, pressing in the middle along the vertical dotted line. Don't press on the lower end of the cable below the horizontal dotted line.

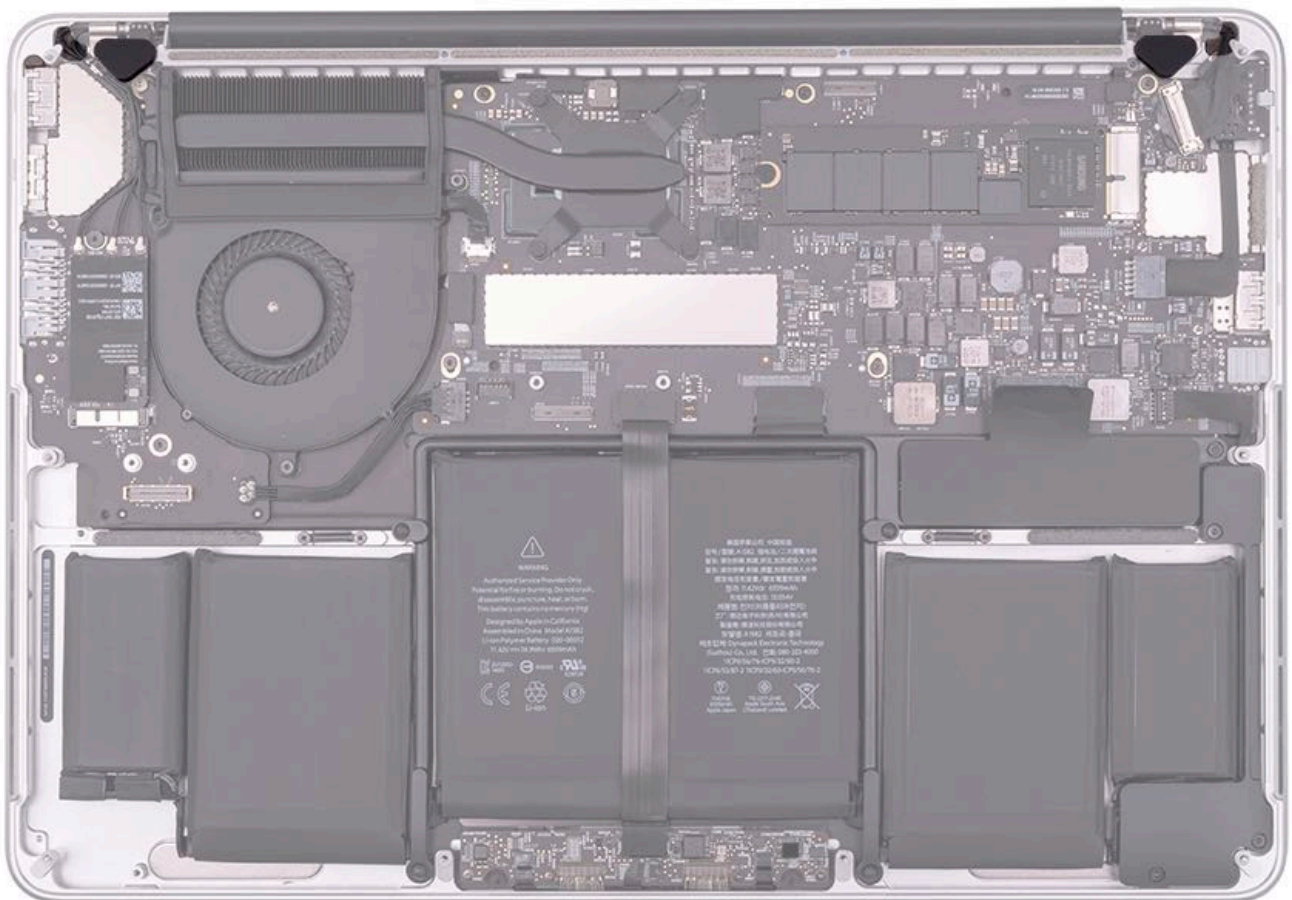


7. Any excess flex cable length should be directed toward the trackpad board and not toward the logic board.

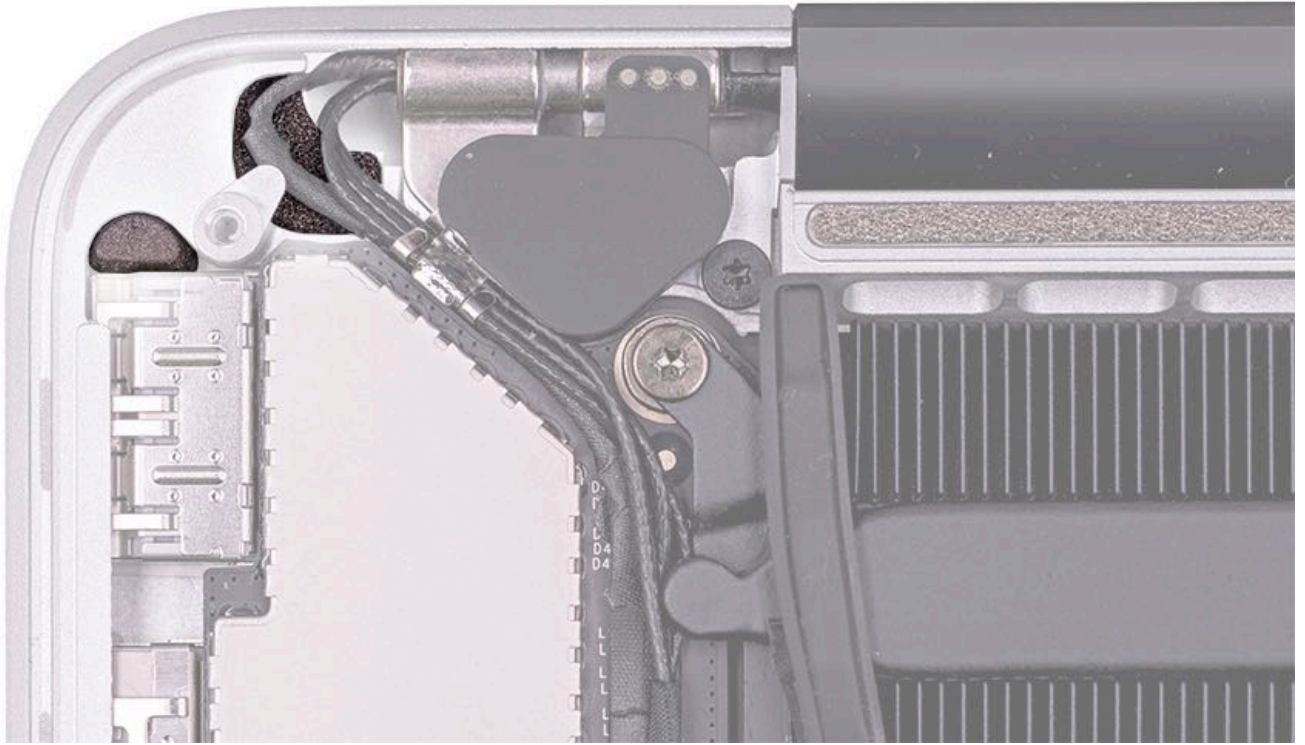




8. Continue with the reassembly in reverse order of removal steps, but before installing the bottom case, make sure to transfer the foam gaskets and clutch covers to the replacement top case.



Check that two foam gaskets are present in the top case, on the top left side. Previous models have only the larger foam gasket.



9. **Important:** After replacing the top case on MacBook Pro (Retina, 13-inch, Early 2015), you must:

- Verify trackpad performance. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
- Use Trackpad Keyboard Mapper in AST 2. Trackpad Keyboard Mapper programs the keyboard language, layout, and function key mapping data into the trackpad whenever the top case assembly has been replaced. For more information about AST 2, refer to article [TP1105: AST 2 Reference Guide](#).

# Apple USB SuperDrive

## First Steps

**Important:** The following procedure is intended only for removing a stuck disc from an Apple USB SuperDrive at the user's request. Do not take apart an Apple USB SuperDrive for repair. The repair strategy for this product is Whole Unit Replacement.

This procedure requires placing SuperDrive upside down on its top case. Always use a clean, debris-free static mat to avoid scratches and other cosmetic damage to the housing.



## Tools

- ESD wrist strap and mat
- Black stick (922-5065)
- #000 Phillips screwdriver
- T10 Torx screwdriver (later models)
- Suction cup (922-8252)





## Steps For Removal

Because this is a handheld procedure, perform these steps over a workbench or elevated repair surface to minimize height from which a component might fall.

1. Hold SuperDrive securely in one hand by edges of silver top case, with black bottom case facing up and USB cable leading away from you.



2. With other hand, place suction cup on center of bottom case. Press down firmly to flatten and secure suction cup.



3. Once suction cup is fully adhered, lift straight up. Pull bottom case directly out of top case in one smooth motion. Secure fit might give a lot of resistance.

**Important:** Adhesion of suction cup is short-lived. To avoid damage from dropping, immediately set bottom case on a clean surface. Be mindful of tabs.

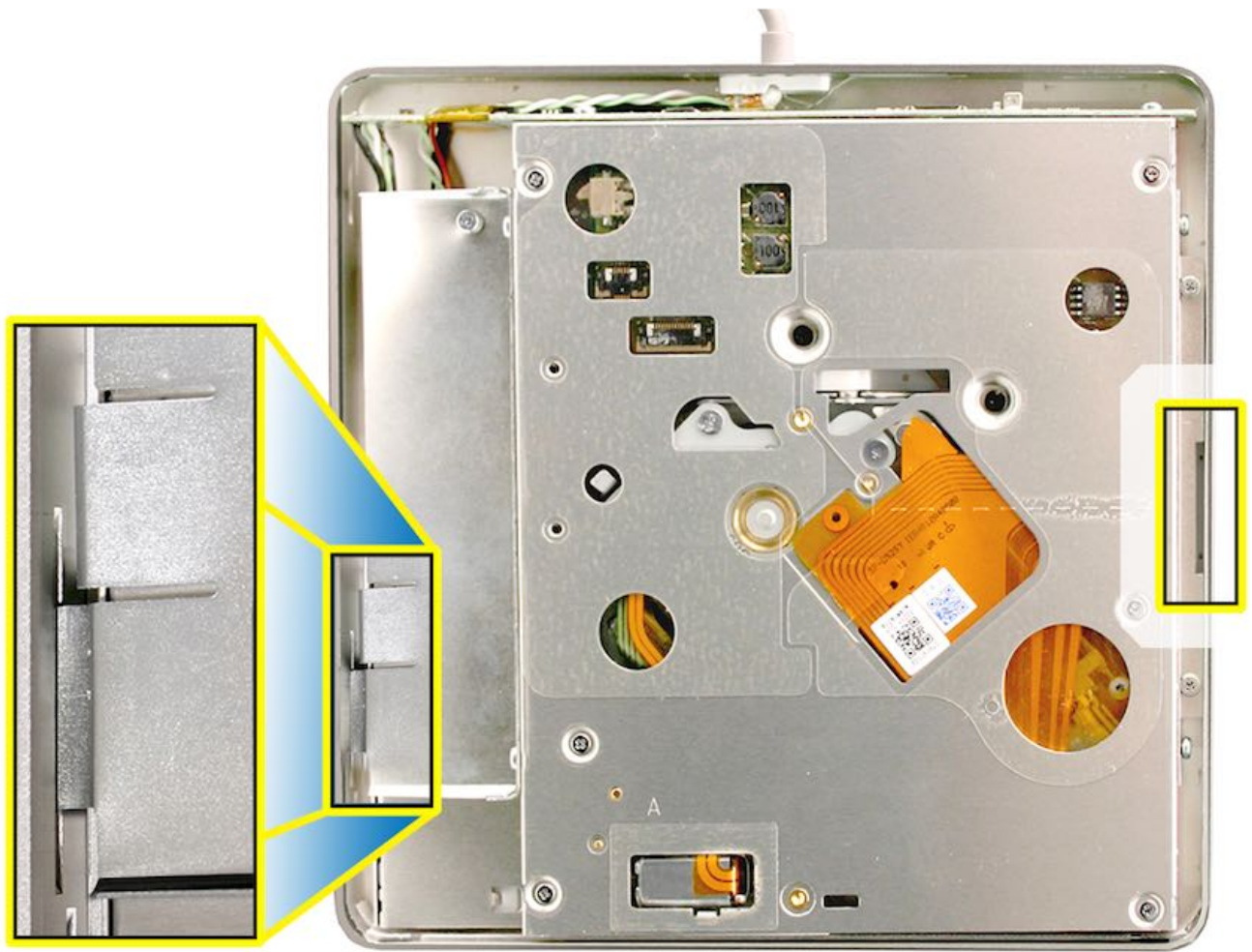


4. Set drive top-down on a soft, clean surface, with inside facing up and USB cable leading away from you. Remove three #000 Phillips screws (shown below).



5. Note tab on lower left of drive fits into recessed slit on inside edge of top case (see below left). On opposite side of drive, note gap in center of right edge of drive (see below right).





6. Insert flat edge of black stick into gap on right edge of drive. Carefully pivot edge upward slightly, just enough to slide drive a few millimeters right. Ease left tab out of top case.



7. Note internal cable leading to external USB cable. In earlier model you will see a controller board connected to cable (see inset below).

**Caution:** Since cable remains connected during this procedure, be careful not to pull or stress cable connections. To avoid



damaging cable, always keep drive within an inch or so of outer case.

8. Grip drive by edges. Avoid touching components. Lift drive up and out of top case a few millimeters — enough to pivot and flip drive over.



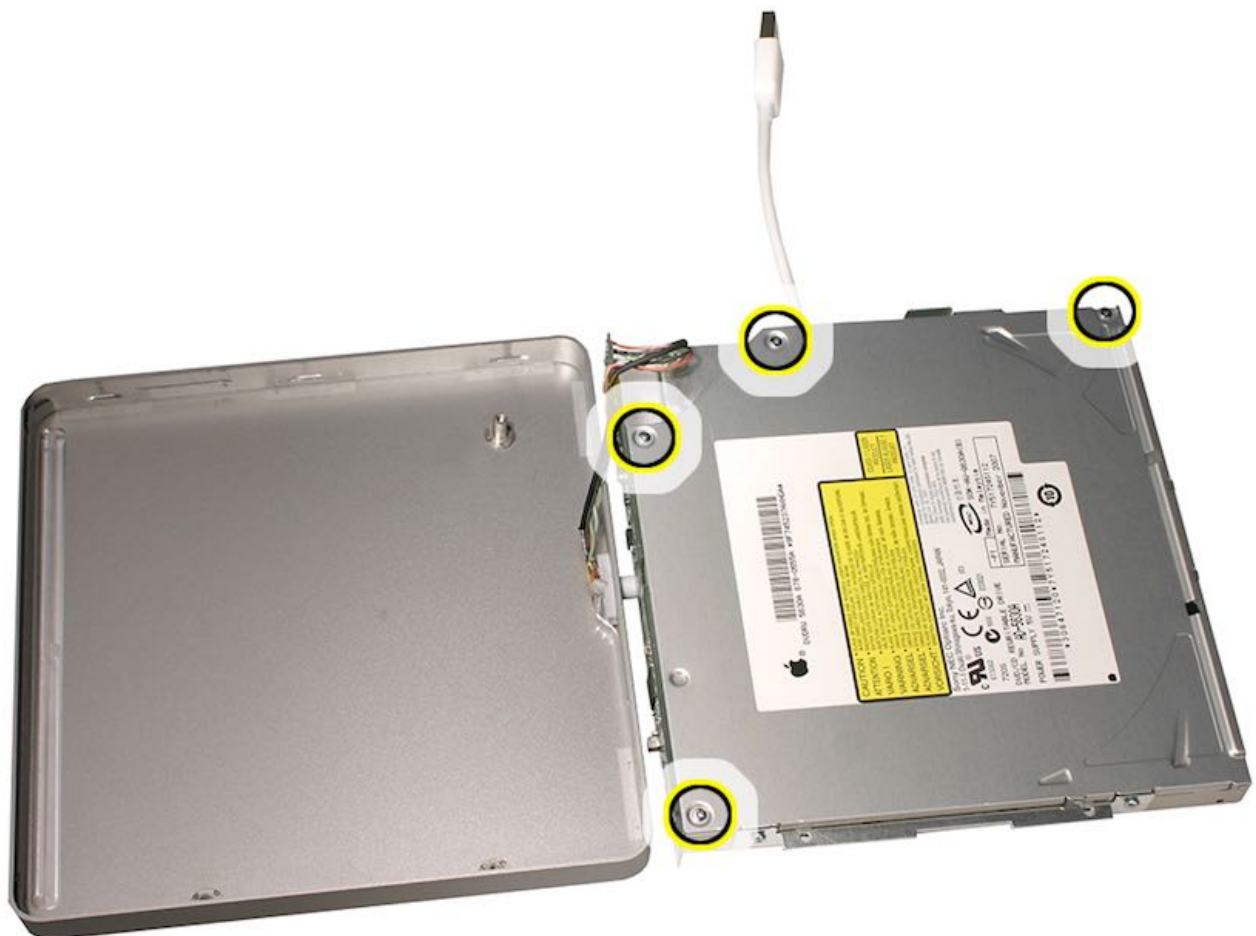
9. As if opening a book, flip drive up and over. Gently lay it down, keeping edges as close together as possible to avoid straining cable connections.



10. Immobilize drive while removing screws or components, holding drive by bracket or edges only.



11. Remove four #000 Phillips screws from top of drive (shown below).



12. Remove two T10 screws or two Phillips screws (depending on model) holding bracket to drive.

**Earlier model:**



Later models:



13. Lift top lid of drive, pivoting right edge up. Then shift lid left and downward to remove left edge.





14. Remove stuck disc. Reassemble SuperDrive in reverse order of previous steps 4-13. Proceed to step 15 to correctly reinstall bottom case.



15. Orient bottom case to top case, as pictured below. Note three tabs per side on left and right sides of drive and two corner tabs in back. There are no tabs in front (where disc slot is located).

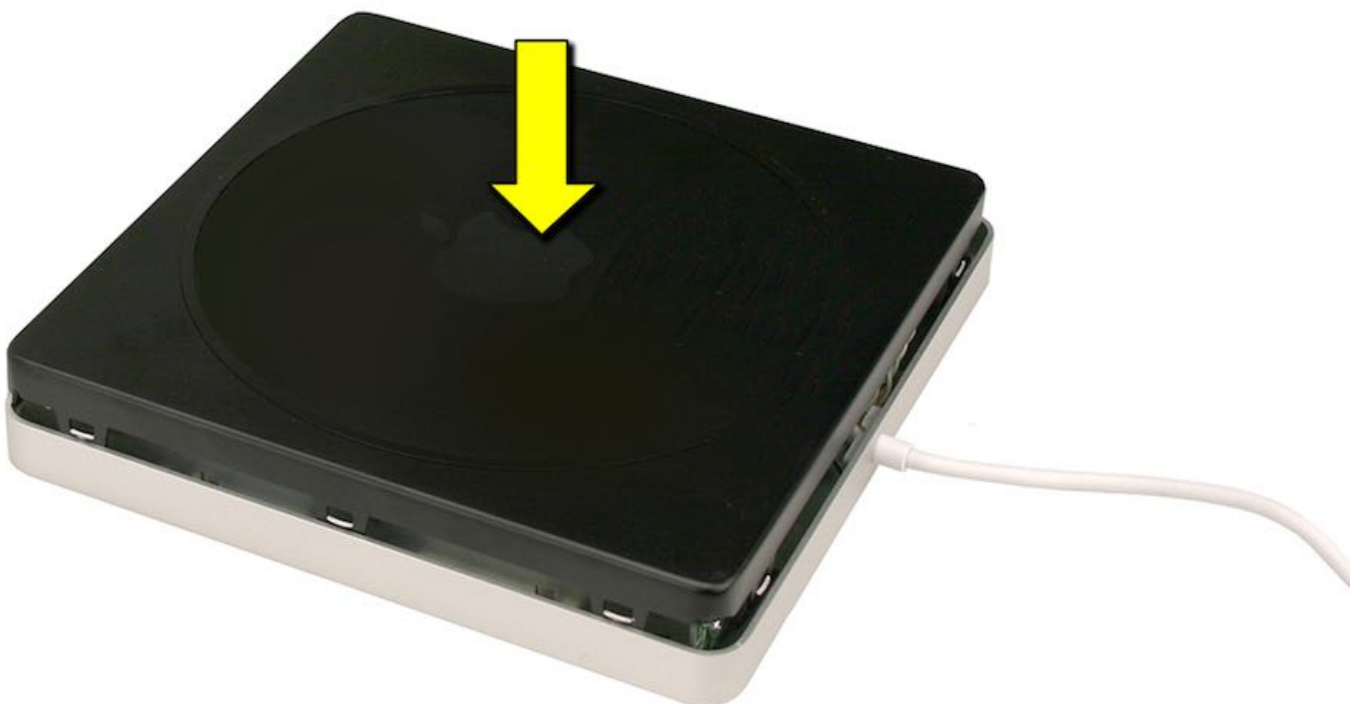




16. Set bottom case evenly on top case with tabs just inside perimeter of top case edge. Align all tabs with top case.

**Note:** If case is oriented correctly, Apple logo will be right-side up when USB cable is pointed toward you.

17. With firm, even pressure, snap bottom case into top case to seat tabs. Verify all tabs are fully seated and SuperDrive sits flat.



## Steps For Reassembly

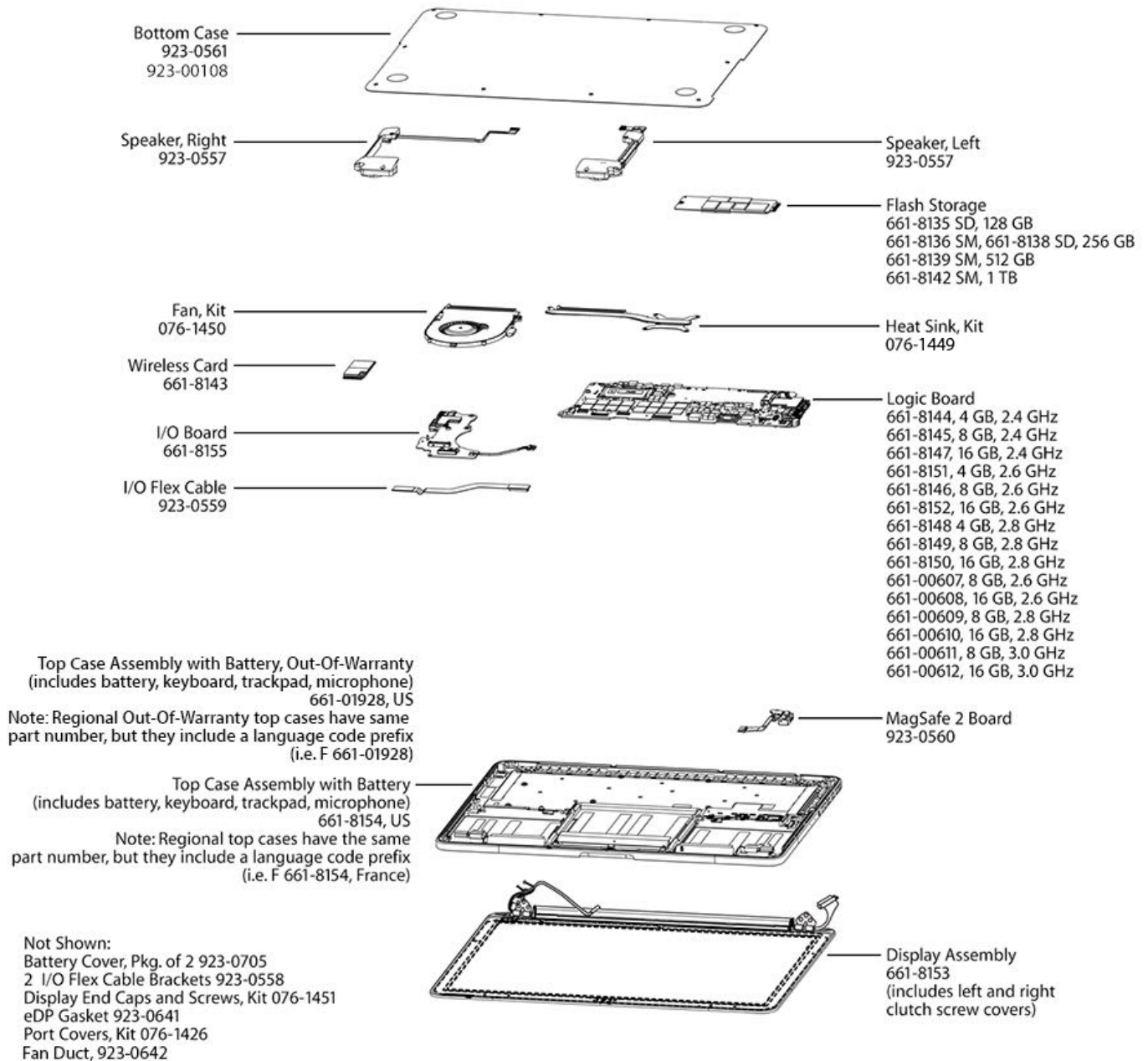
Reassemble in reverse order of removal steps.

### **Quick Test**

Plug Apple USB SuperDrive into known-good computer to check functionality. Check drive for disc insertion, mounting, and ejection of a variety of optical media.

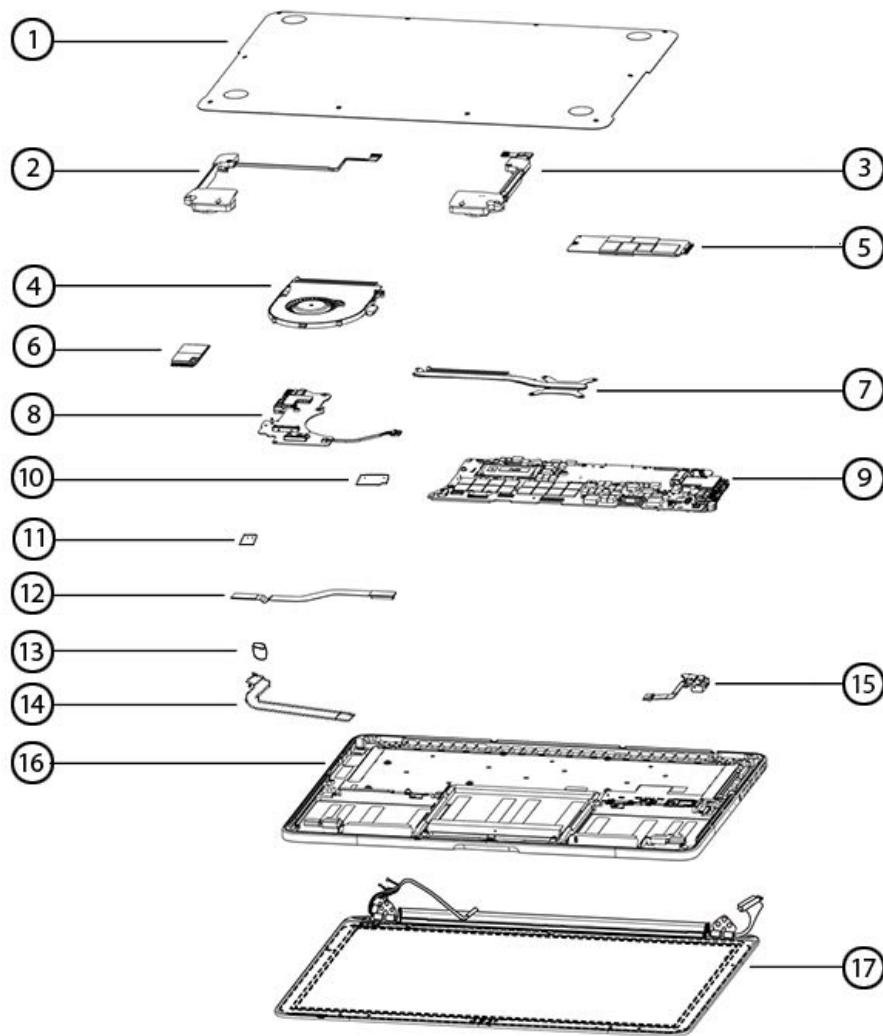
# Exploded View

## Exploded View



# Exploded View

## Exploded View for MacBook Pro (Retina, 13-inch, Early 2015)



### 1. Bottom Case

- 923-0053

### 2, 3. Speaker, Left and Right

- 923-00509

### 4. Fan, Kit

- 076-00071

### 5. Flash Storage

- 661-02350, 128GB
- 661-02351, 256GB
- 661-02352, 512GB
- 661-02353, 1TB

### 6. Wireless Card

- 661-02363

### 7. Heat Sink, Kit

- 076-00072



## 8. I/O Board

- 661-02457

## 9. Logic Board

- 661-02354, 2.7 GHz, 8GB
- 661-02355, 2.7 GHz, 16GB
- 661-02356, 2.9 GHz, 8GB
- 661-02357, 2.9 GHz, 16GB
- 661-02358, 3.1 GHz, 8GB

## 10. I/O Flex Bracket Right

- 923-00516

## 11. I/O Flex Bracket Left

- 923-00515

## 12. I/O Flex Cable

- 923-0559

## 13. Top Case Gasket

- 923-00519

## 14. IPD Flex Cable

- 923-00518

## 15. MagSafe 2 Board

- 923-00517

## 16. Top Case Assembly with Battery (includes battery, keyboard, trackpad, and microphone)

- 661-02361, US
- 661-02362, US, Out-of-Warranty

**Note:** Regional top cases have the same part number, but they include a language code prefix. Example: F661-02361 is for France.

## 17. Display Assembly

- 661-02360 (includes left and right clutch screw covers)

### Not shown:













- Battery Cover, pkg of 2, 923-0705
- Display End Caps and Screws Kit, 076-00073
- Port Covers Kit, 076-1426
- Power Adapter, 661-00681, US













**Note:** Regional power adapters have the same part number, but they include a language code prefix. Example: CH661-00681 is for China.











- Weight Test Kit, 923-00462
- Power Cord, 922-9173

# Screw Chart

## MacBook Pro (Retina, 13-inch, Late 2012, Early 2013, Late 2013, Mid 2014, Early 2015)

<p><b>076-1410</b> Torx T5</p>  <p>Display End Cap (2)</p> <p><b>Note:</b> Kit includes end caps and screws</p>	<p><b>922-9651</b> Torx T5</p>  <p>SSD Card or Flash Storage (1)</p>	<p><b>923-0131</b> Pentalobe</p>  <p>Bottom Case (8), (Late 2012, Early 2013)</p>
<p><b>923-0132</b> Pentalobe</p>  <p>Bottom Case (2)</p>	<p><b>923-0139</b> Torx T8</p>  <p>Display Assembly (6)</p>	<p><b>923-0140</b> Torx T5</p>  <p>Heat Sink (4), center</p>
<p><b>923-0232</b> Torx T5</p>  <p>Trackpad (6), battery tray (Late 2012 and Early 2013 only)</p>	<p><b>923-0233</b> Torx T5</p>  <p>Speaker (1), corner (Late 2012 and Early 2013 only)</p>	<p><b>923-0234</b> Torx T5</p>  <p>I/O Board (1), near cable (Late 2012, Early 2013); Logic Board (2), lower edge (Late 2012, Early 2013)</p>
<p><b>923-0235</b> Torx T5</p>  <p>Heat Sink (1), near eDP cable (Late 2012, Early 2013); Logic Board (5); MagSafe (2); I/O Board (1), near cable</p>	<p><b>923-0236</b> Torx T5</p>  <p>Left/Right Fan (3) (Late 2012, Early 2013);</p>	<p><b>923-0237</b> Torx T8 Shoulder screw</p>  <p>I/O Board (1) (Late 2013, Mid 2014)</p> <p><b>Note:</b> The I/O screw is accessible once the screw (923-0238) on thermal module is removed.</p>

<b>923-0238</b> Phillips #0 <div data-bbox="221 226 285 291"></div> <div data-bbox="145 389 601 454">Heat Sink (1), near I/O (Late 2012, Early 2013, Late 2013, Mid 2014)</div>	<b>923-0239</b> Torx T6 <div data-bbox="719 226 788 300"></div> <div data-bbox="639 389 1000 454">Interposer (2), BMU (Late 2012, Early 2013)</div>	<b>923-0240</b> Torx T6 <div data-bbox="1114 219 1214 295"></div> <div data-bbox="1050 389 1495 454">Interposer (1), BMU (Late 2012, Early 2013)</div>
<b>923-0241</b> Torx T5 <div data-bbox="201 663 272 707"></div> <div data-bbox="145 813 616 851">Speaker (1), front (Late 2012, Early 2013)</div>	<b>923-0242</b> Torx T5 <div data-bbox="699 649 804 694"></div> <div data-bbox="639 799 1026 864">Speaker (1), top (Late 2012, Early 2013)</div>	<b>923-0243</b> Torx T5 <div data-bbox="1129 663 1190 703"></div> <div data-bbox="1050 813 1519 851">Audio board (2) (Late 2012, Early 2013)</div>
<b>923-0287</b> Torx T6 <div data-bbox="202 1046 301 1144"></div> <div data-bbox="145 1225 612 1290">Trackpad (1), set screw (Late 2012, Early 2013)</div>	<b>923-0288</b> Phillips #00 <div data-bbox="707 1046 783 1140"></div> <div data-bbox="639 1234 1010 1299">Trackpad (4), lower flexure (Late 2012, Early 2013)</div>	<b>923-0290</b> Phillips #00 <div data-bbox="1129 1061 1190 1128"></div> <div data-bbox="1050 1225 1513 1290">Trackpad (4), upper flexure (Late 2012, Early 2013)</div>
<b>923-0291</b> Torx T6 <div data-bbox="165 1435 341 1554"></div> <div data-bbox="145 1659 622 1724">BMU Interlock Screw (1) (Late 2012, Early 2013)</div>	<b>923-0314</b> Torx T5 <div data-bbox="715 1503 775 1570"></div> <div data-bbox="639 1668 844 1702">Wireless Card (1)</div>	<b>923-0644</b> Torx T5 <div data-bbox="1110 1503 1219 1547"></div> <div data-bbox="1050 1653 1506 1718">Speaker (1), top (Late 2013, Mid 2014, Early 2015)</div>

<p><b>923-0645</b> Pentalobe</p>  <p>Bottom Case (8), (Late 2013, Mid 2014, Early 2015)</p>	<p><b>923-0647</b> Torx T5</p>  <p>Speaker (1), corner (Late 2013, Mid 2014, Early 2015)</p>	<p><b>923-0650</b> Torx T5</p>  <p>Display End Cap (2)</p> <p><b>Note:</b> Screw only; kit does not include end cap.</p>
<p><b>923-0651</b> Torx T5</p>  <p>Speaker (1), front (Late 2013, Mid 2014, Early 2015)</p>	<p><b>923-00605</b> Phillips #0</p>  <p>Heat Sink (1), near I/O (Early 2015)</p>	<p><b>923-00522</b> Torx T5</p>  <p>Heat Sink (4), center (Early 2015)</p>
<p><b>923-00523</b> Torx T5</p>  <p>I/O flex cable (4) (Early 2015)</p>	<p><b>923-00525</b> Torx T5</p>  <p>I/O Board (1), near display hinge (Early 2015)</p>	<p><b>923-00109</b> Torx T5</p>  <p>Fan (1), (Late 2013, Mid 2014, Early 2015)</p>
<p><b>923-0646</b> Torx T5</p>  <p>Fan (2) (Late 2013, Mid 2014, Early 2015)</p>		



# Screw Location Diagrams

## Screw Location Diagrams for MacBook Pro (Retina, 13-inch, Late 2013, Mid 2014, and Early 2015)

**Note:** All screw sizes shown are approximate and represent the total length of the screw.



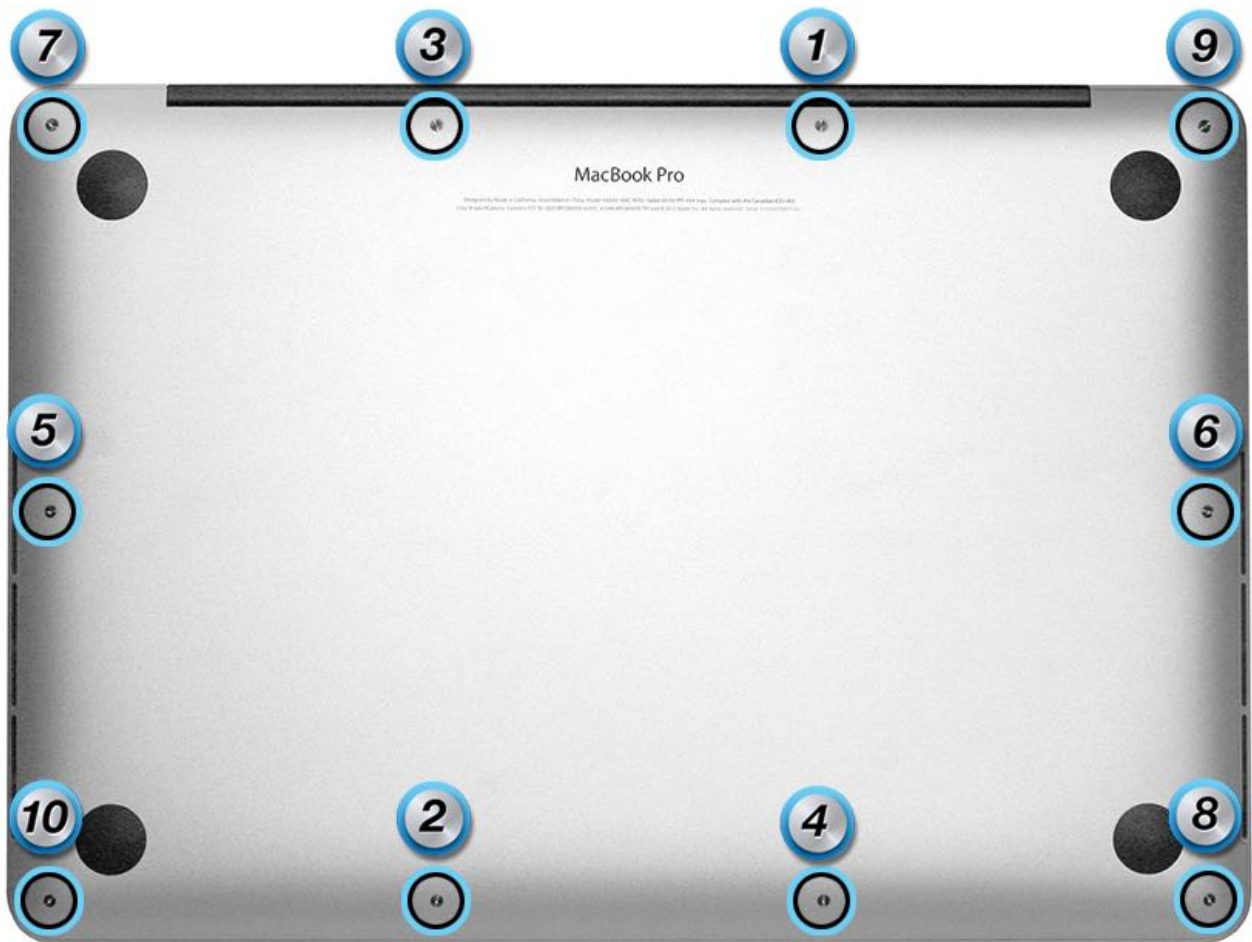
### IMPORTANT:

- Always wear ESD wrist strap and take precautions to avoid ESD.
- Always [attach battery cover and disconnect the battery](#) immediately after removing bottom case.

### Bottom Case

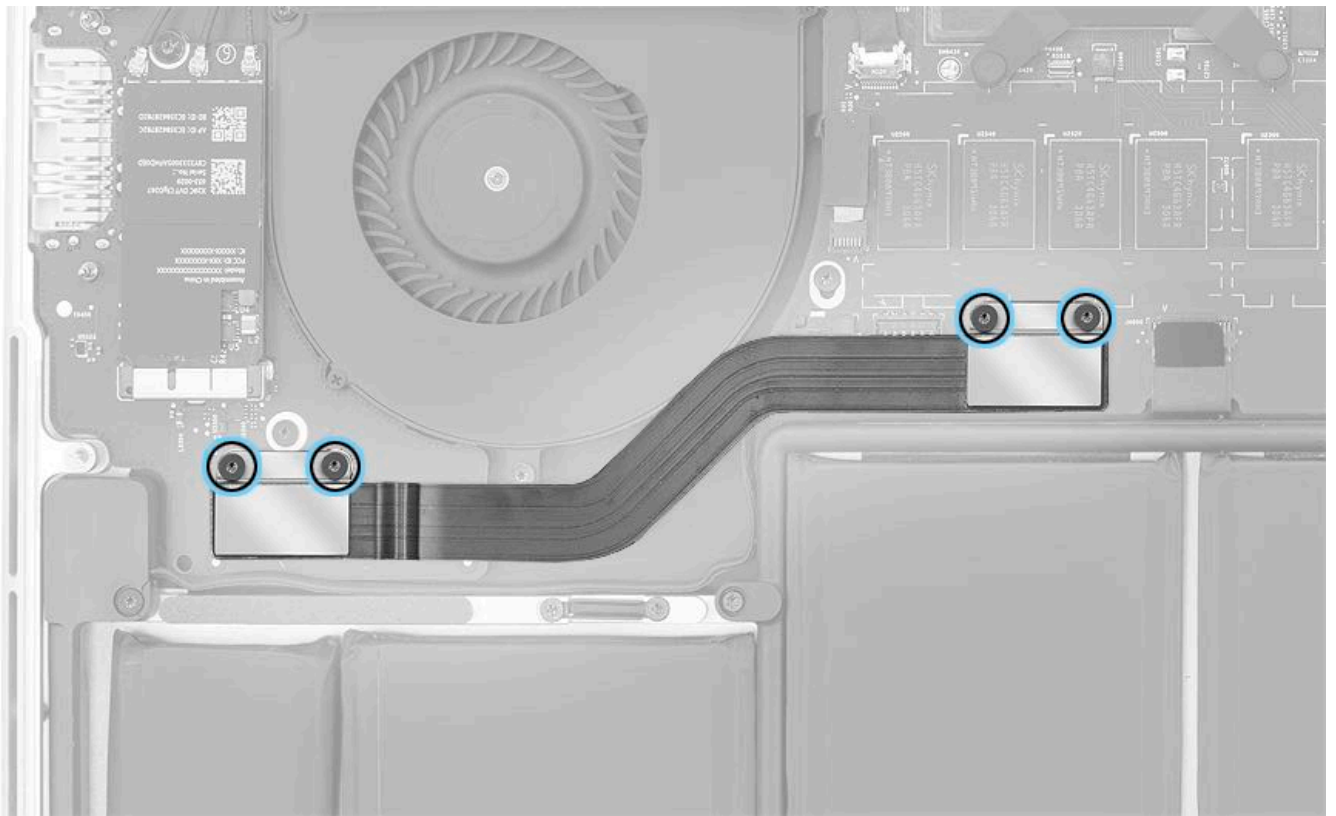
Two 923-0132 (2.32 mm) T5 screws (#1 and #3 in diagram)

Eight 923-0131 (3.14 mm) T5 screws



### I/O Flex Cable

Four 923-0649 (1.6 mm) T5 screws

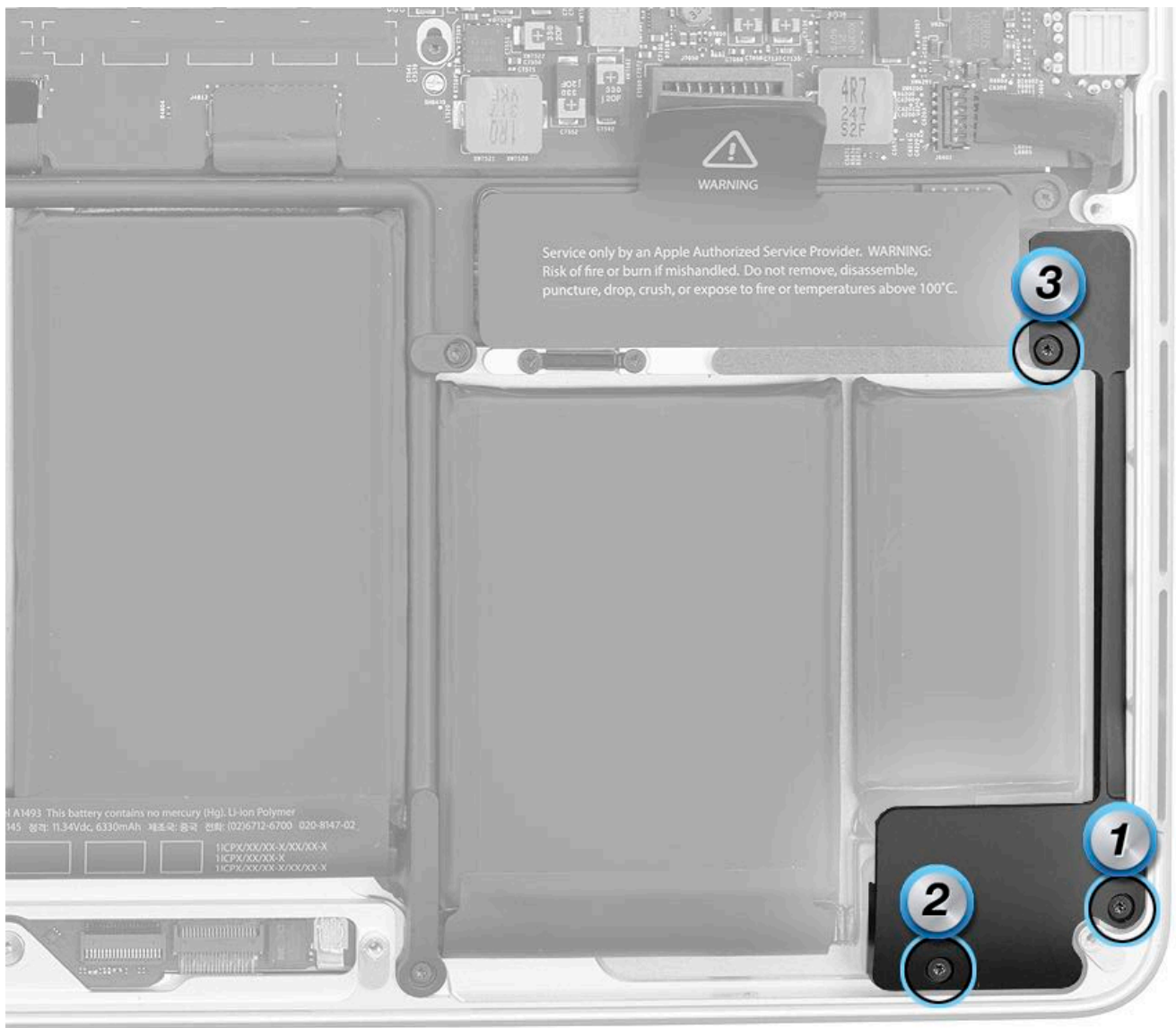


### Left Speaker

One 923-0233 (6.32 mm) T5 screw (#1)

One 923-0241 (4.85 mm) T5 screw (#2)

One 923-0240 (6.75 mm) T5 screw (#3)

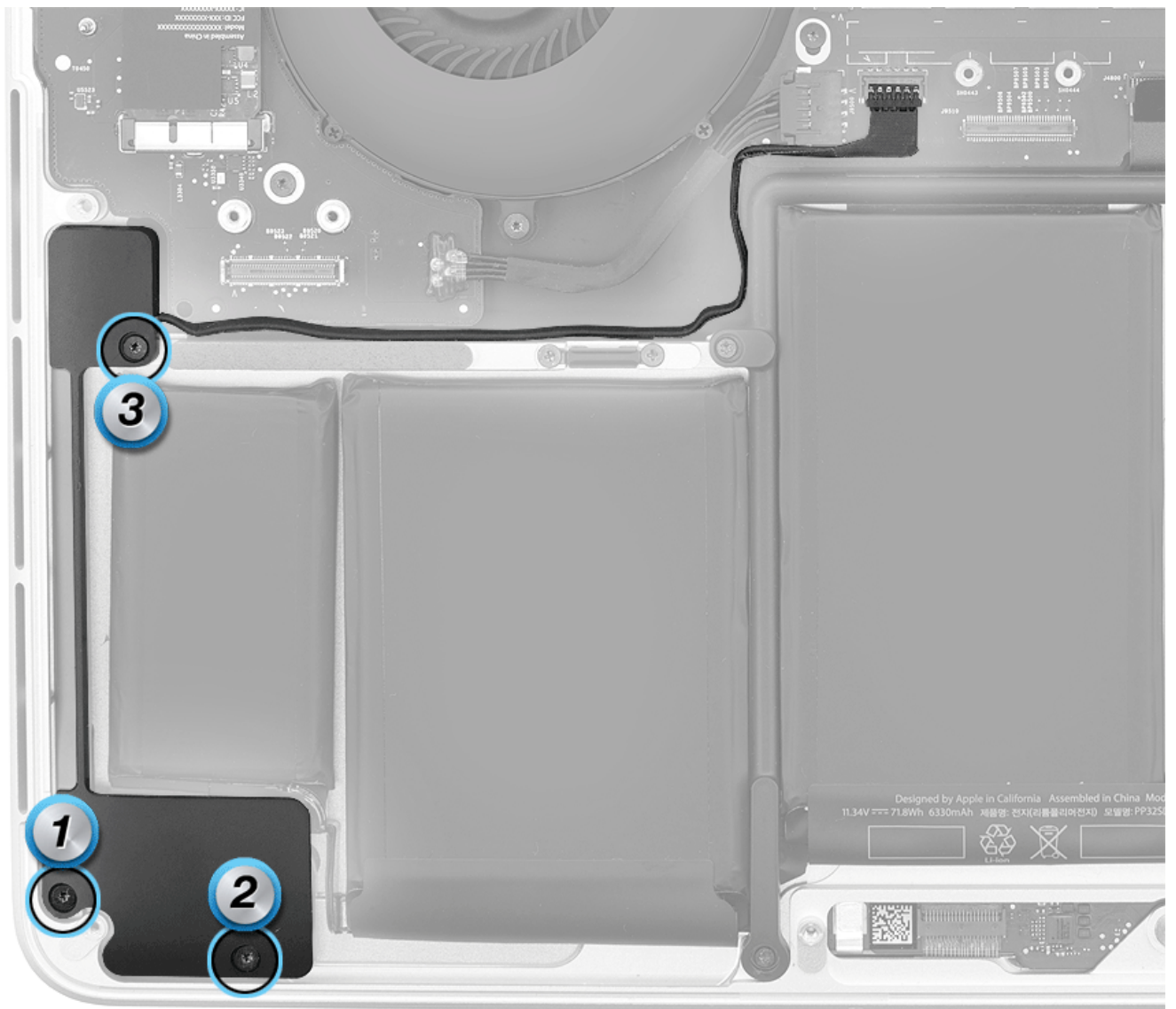


## Right Speaker

One 923-0233 (6.32 mm) T5 screw (#1)

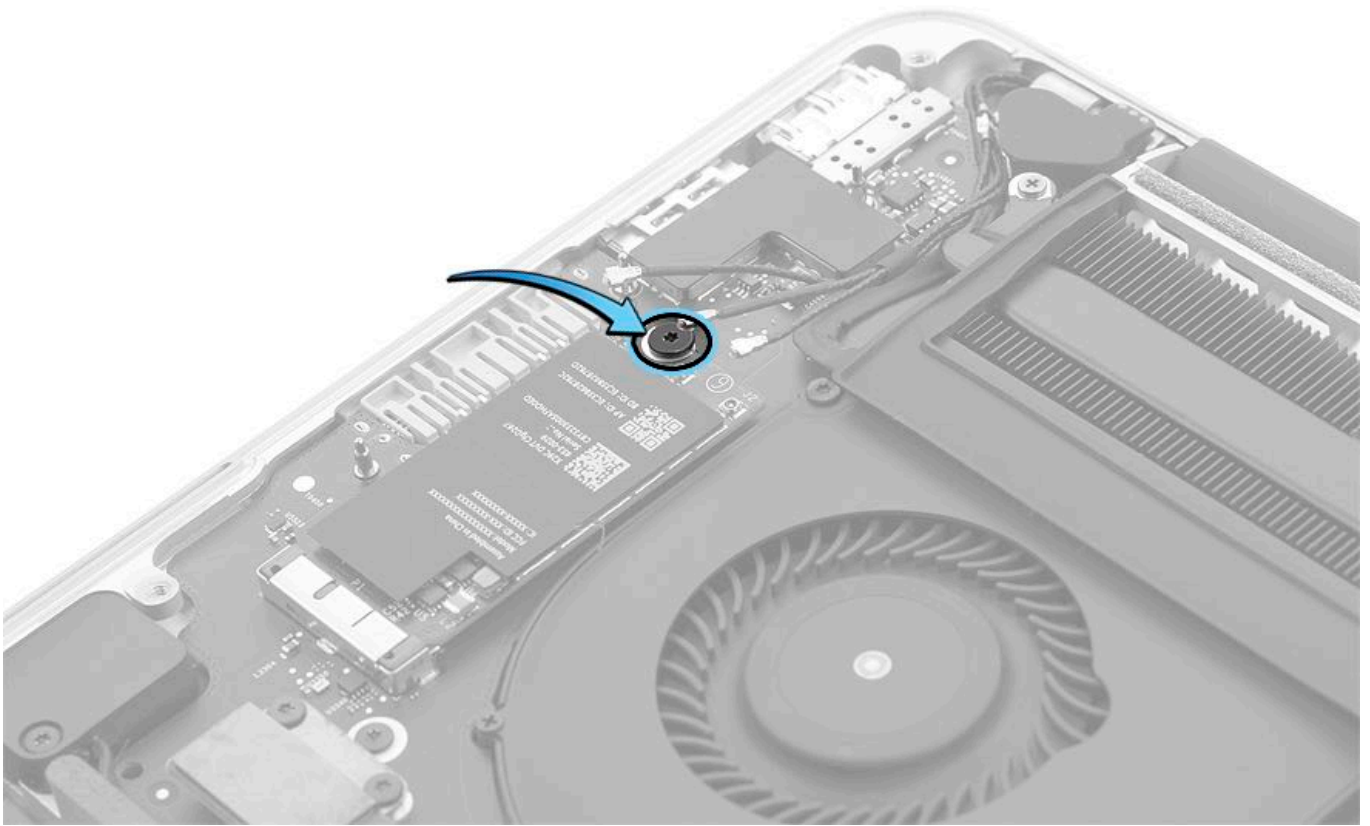
One 923-0241(4.85 mm) T5 screw (#2)

One 923-0240 (6.75 mm) T5 screw (#3)



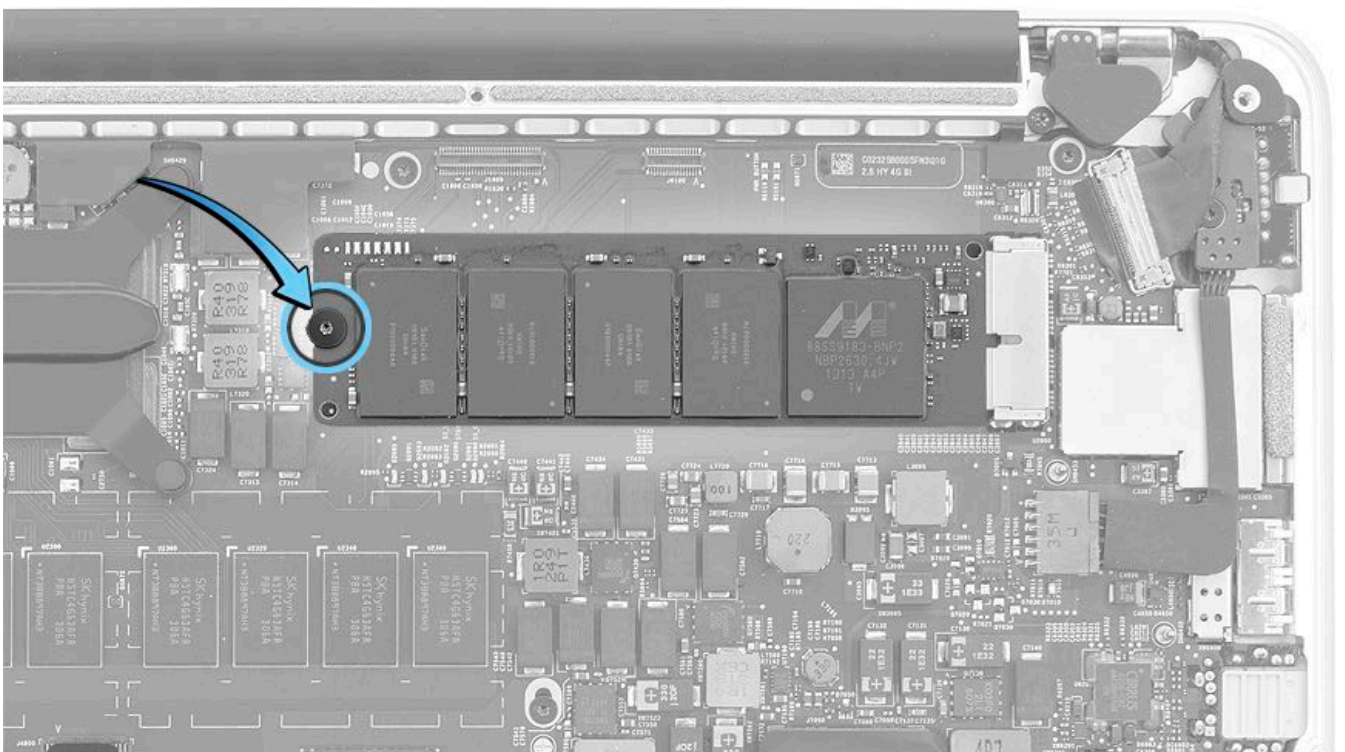
## Wireless Card

One 923-0314 (2.68 mm) T5 screw



### Flash Storage

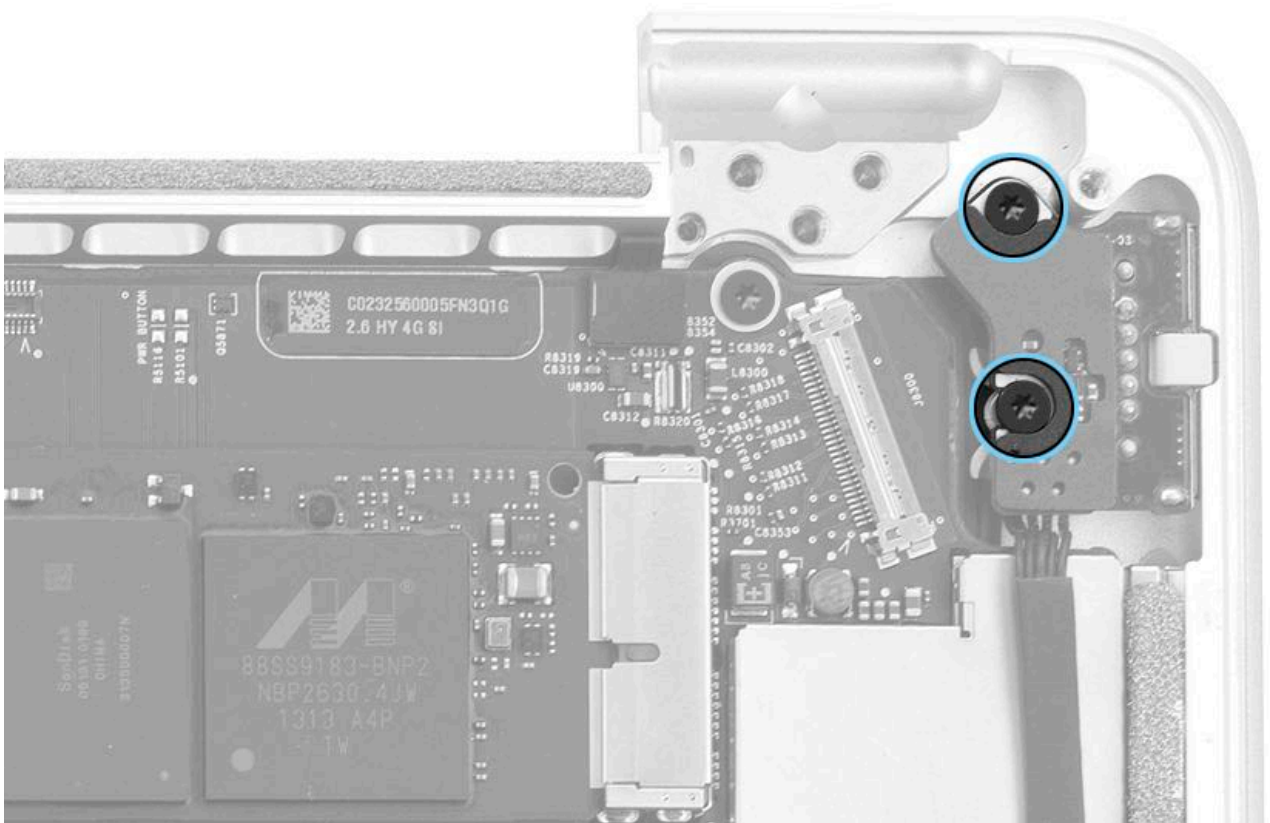
One 922-9651 (2.88 mm) T5 screw



### MagSafe 2 Board

Two 923-0235 (3.43 mm) T5 screw



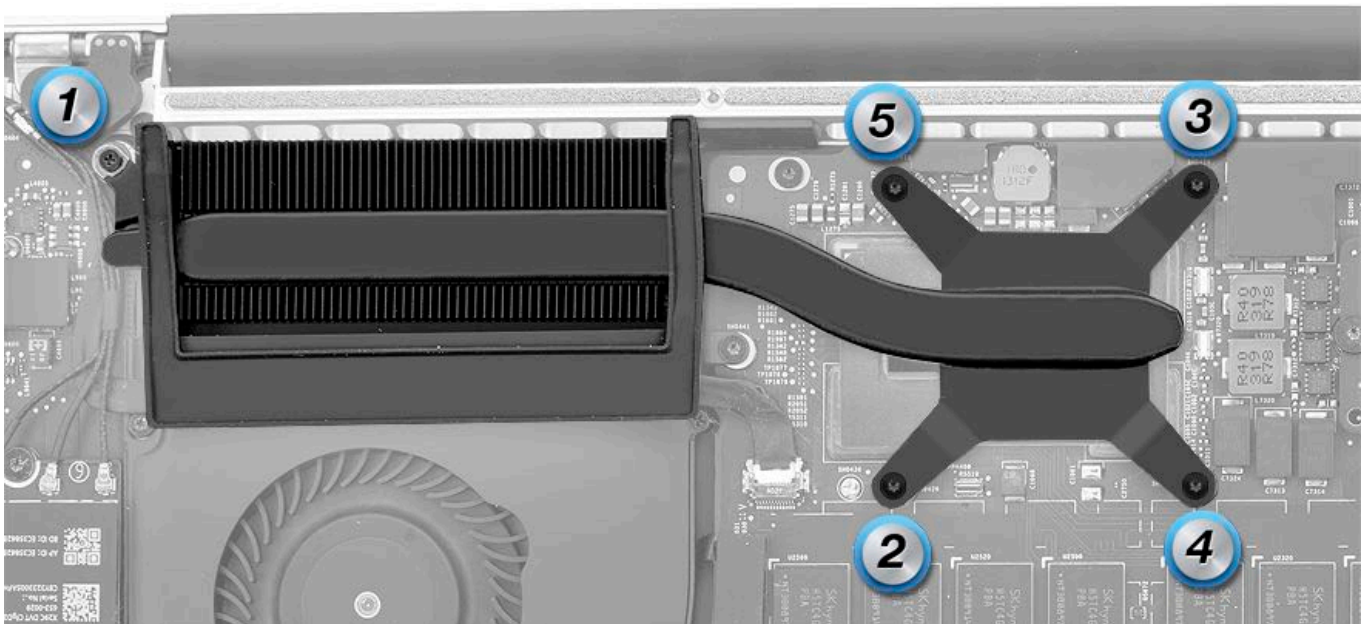


## Heat Sink

Phillips #0 screw (#1)

- One 923-0238, 2.25 mm, (Late 2012, Early 2013, Late 2013, Mid 2014)
- One 923-00605, 2.7 mm, (Early 2015)

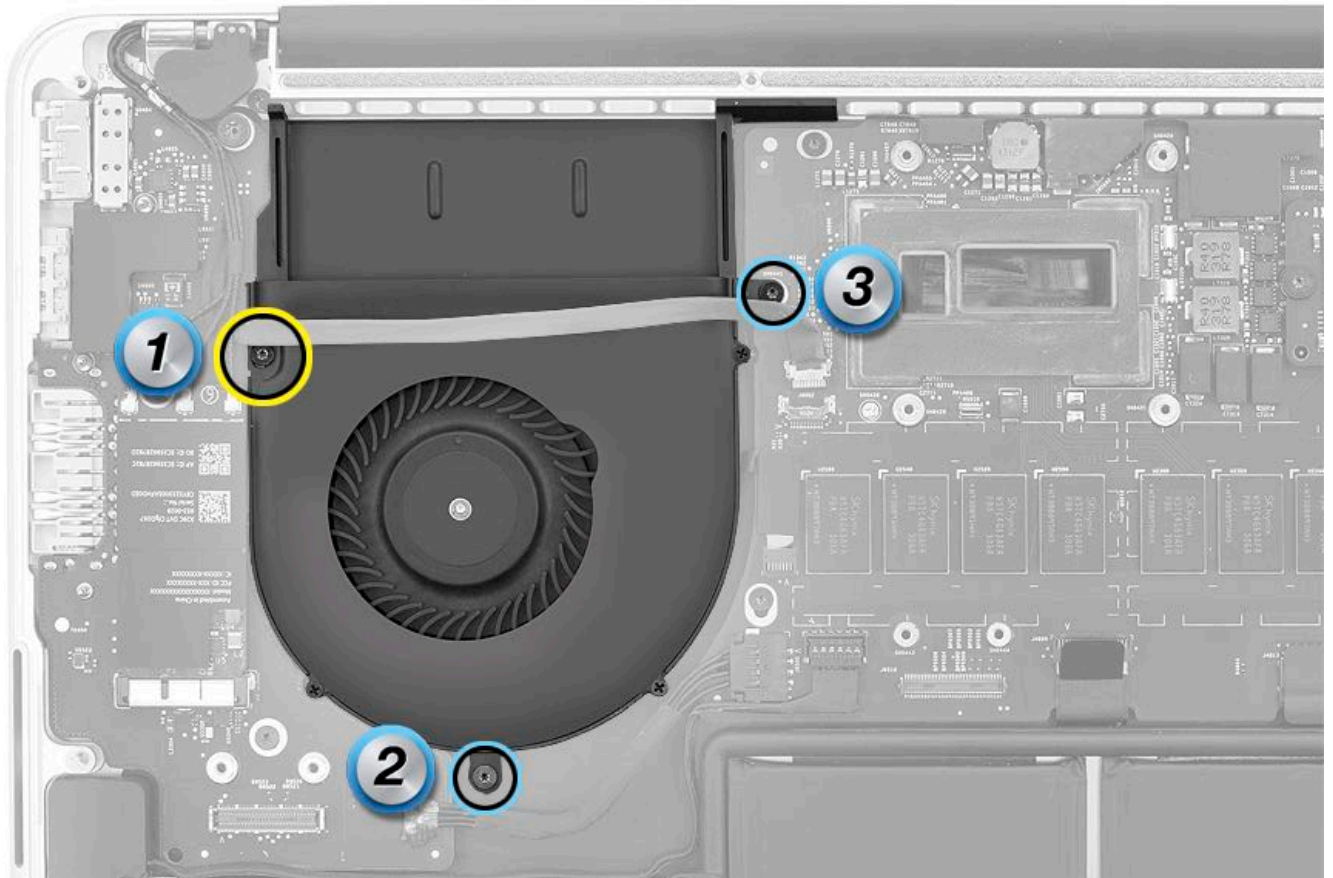
Four 923-0140 (2.57 mm) T5 screws (#2-5)



## Fan

One 923-00109 (3.08 mm) T5 screw (#1)

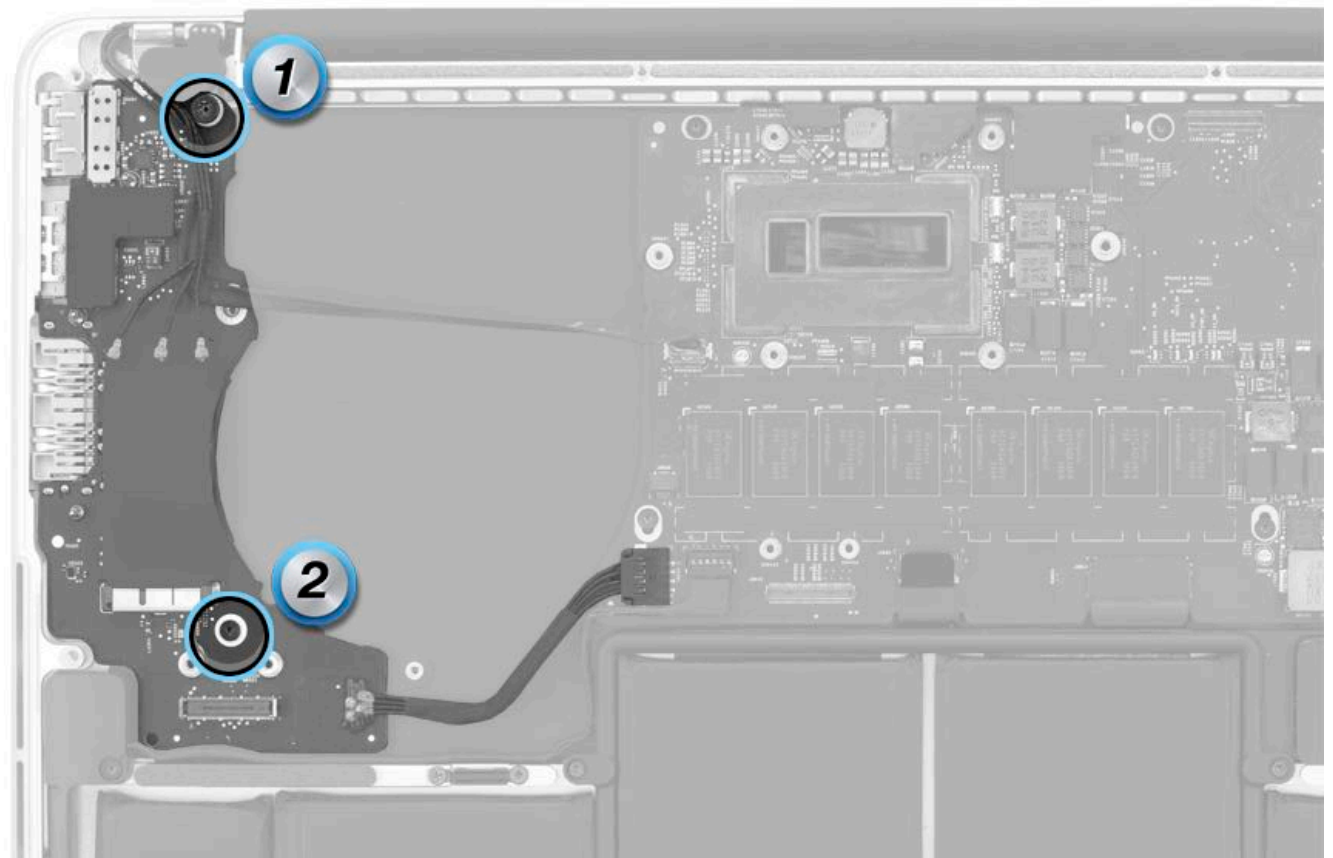
Two 923-0646 (1.6 mm) T5 screws (#2-3)



#### I/O Board

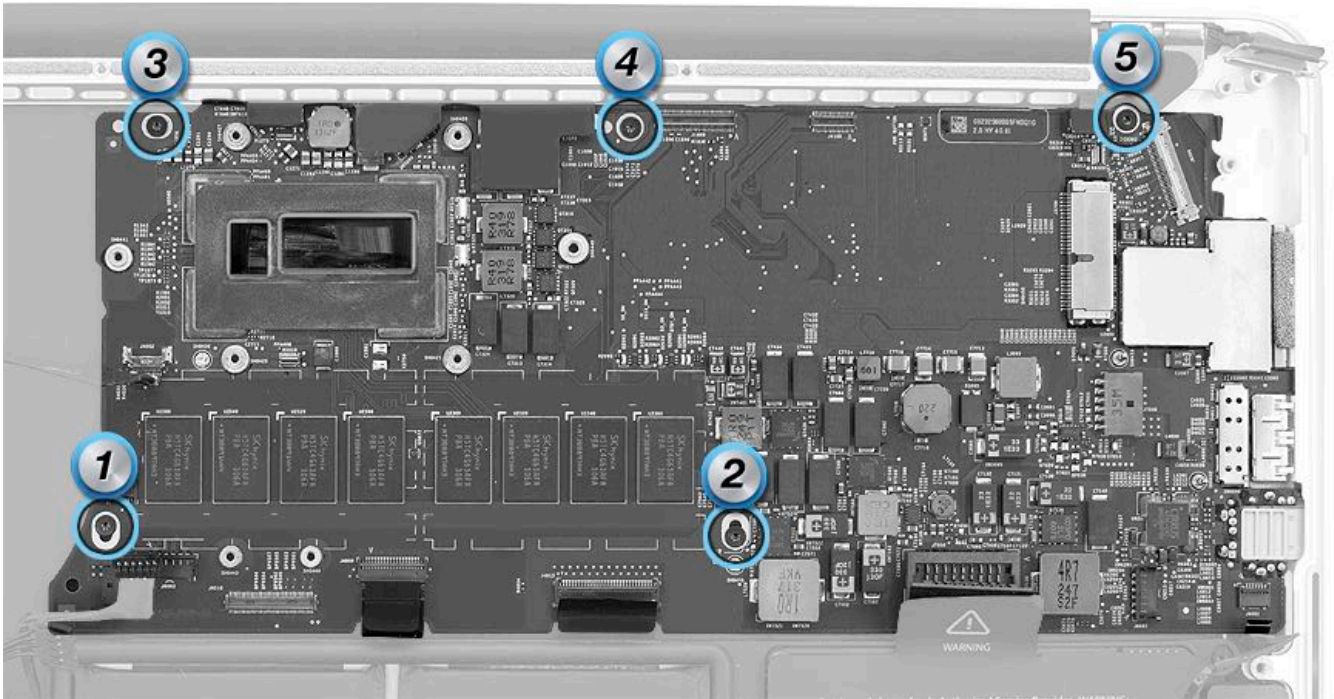
One 923-0237 (4.95 mm) T5 screw (#1)

One 923-0235 (3.43 mm) T5 screw (#2)



#### Logic Board

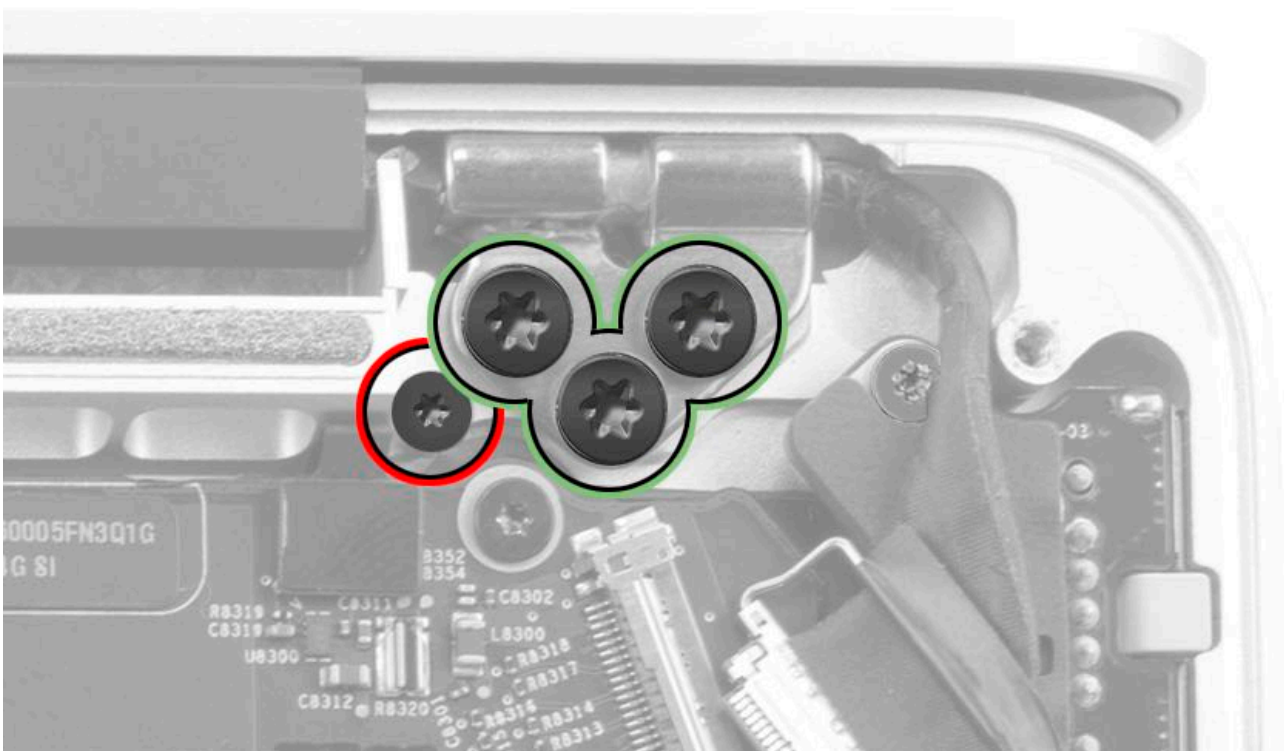
Five 923-0235 (3.43 mm) T5 screws at logic board (#1-5)



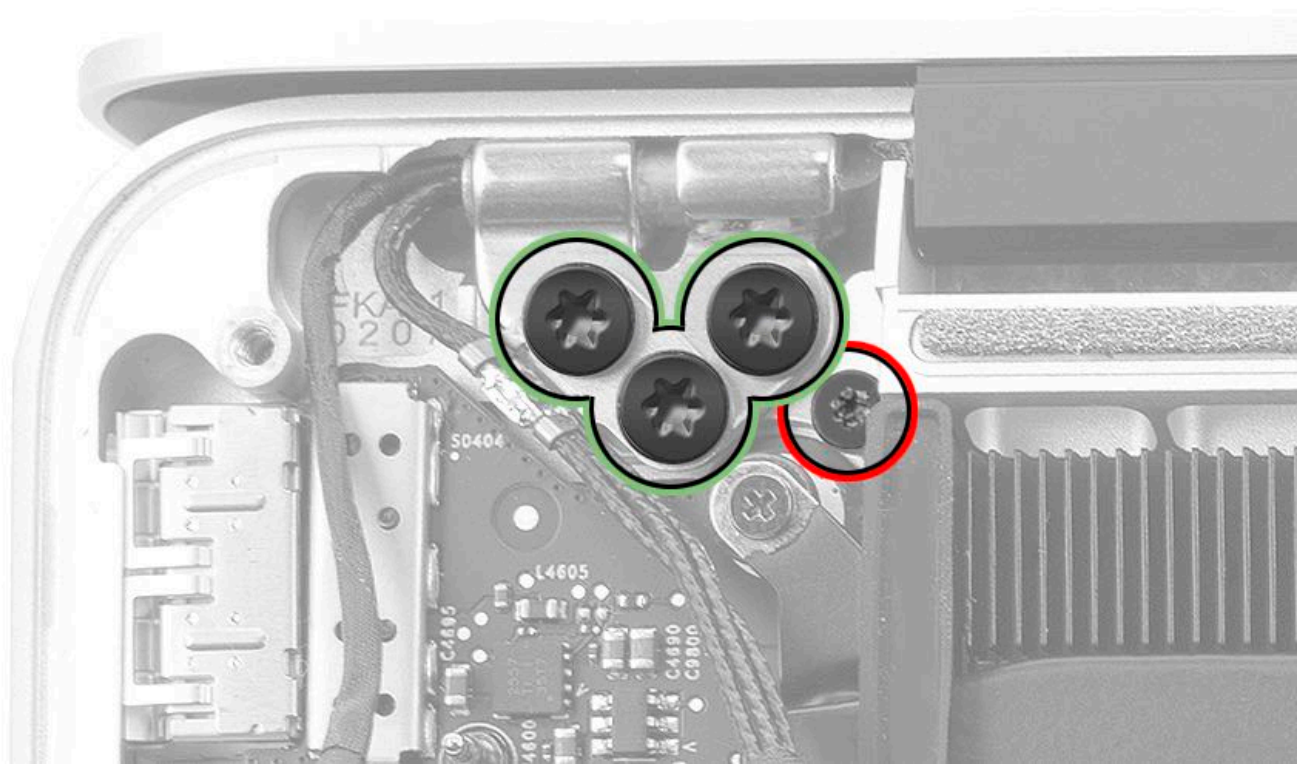
### Display Assembly

Two 076-1410 (3.07 mm) T5 screw (1 at each end cap)

Six 923-0139 (5.20 mm) T8 screws (3 at each display clutch)







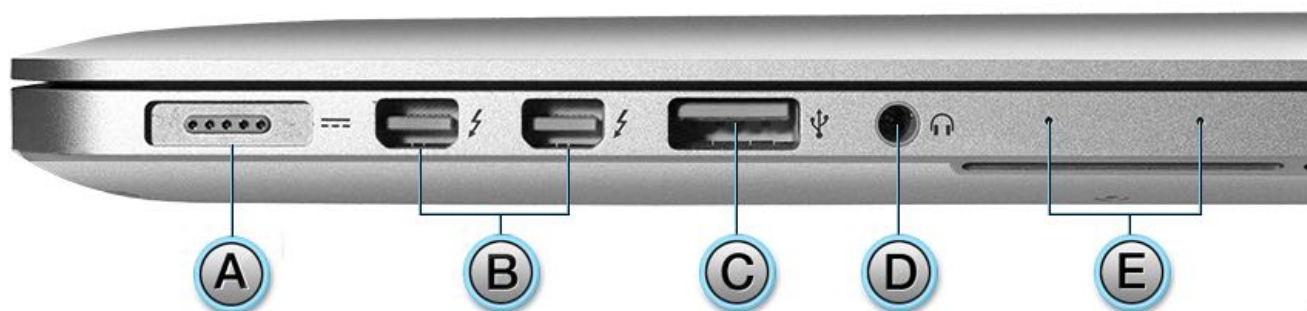
## External Views

External Views of MacBook Pro (Retina, 13-inch, Late 2012, Early 2013, Late 2013, Mid 2014, Early 2015)

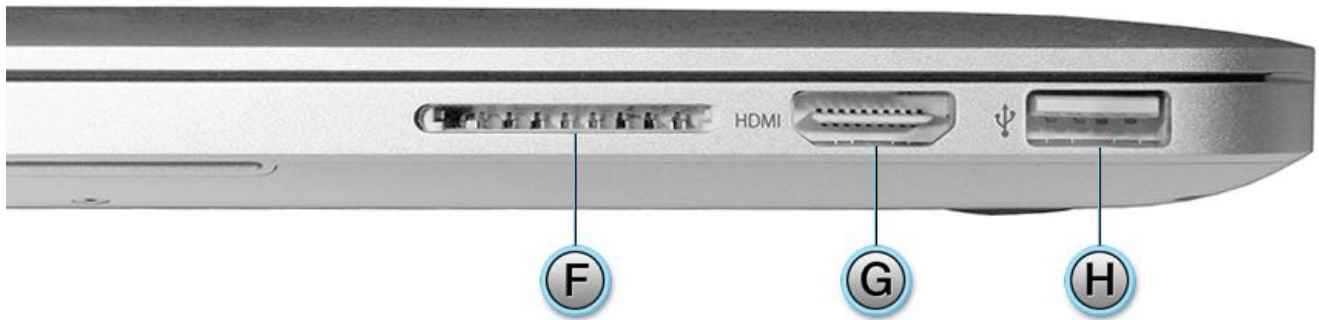
### Front View



### Port View







**A = MagSafe 2 Power**

**B = Thunderbolt (Late 2012 and Early 2013) or Thunderbolt 2 (Late 2013, Mid 2014, and Early 2015)**

**C = USB 3**

**D = Headphone (audio out)**

**E = Dual microphones**

**F = SDXC card slot**

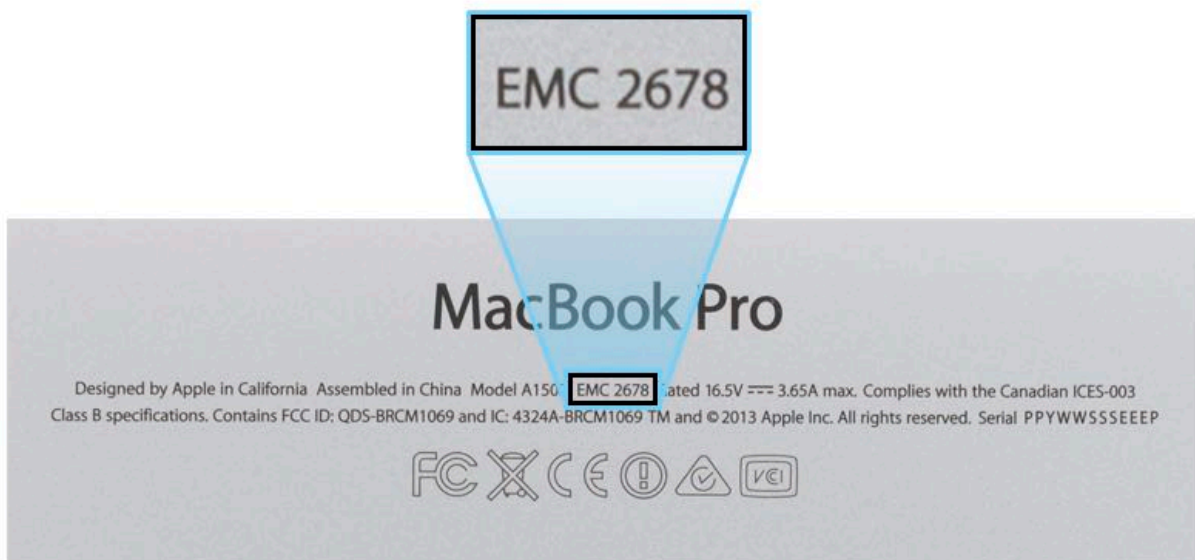
**G = HDMI**

**H = USB 3**

### Bottom Case View

Identify models by the EMC number on the bottom case:

- MacBook Pro (Retina, 13-inch, Late 2012): EMC 2557
- MacBook Pro (Retina, 13-inch, Early 2013): EMC 2672
- MacBook Pro (Retina, 13-inch, Late 2013): EMC 2678, as shown
- MacBook Pro (Retina, 13-inch, Mid 2014): EMC 2875
- MacBook Pro (Retina, 13-inch, Early 2015): EMC 2835

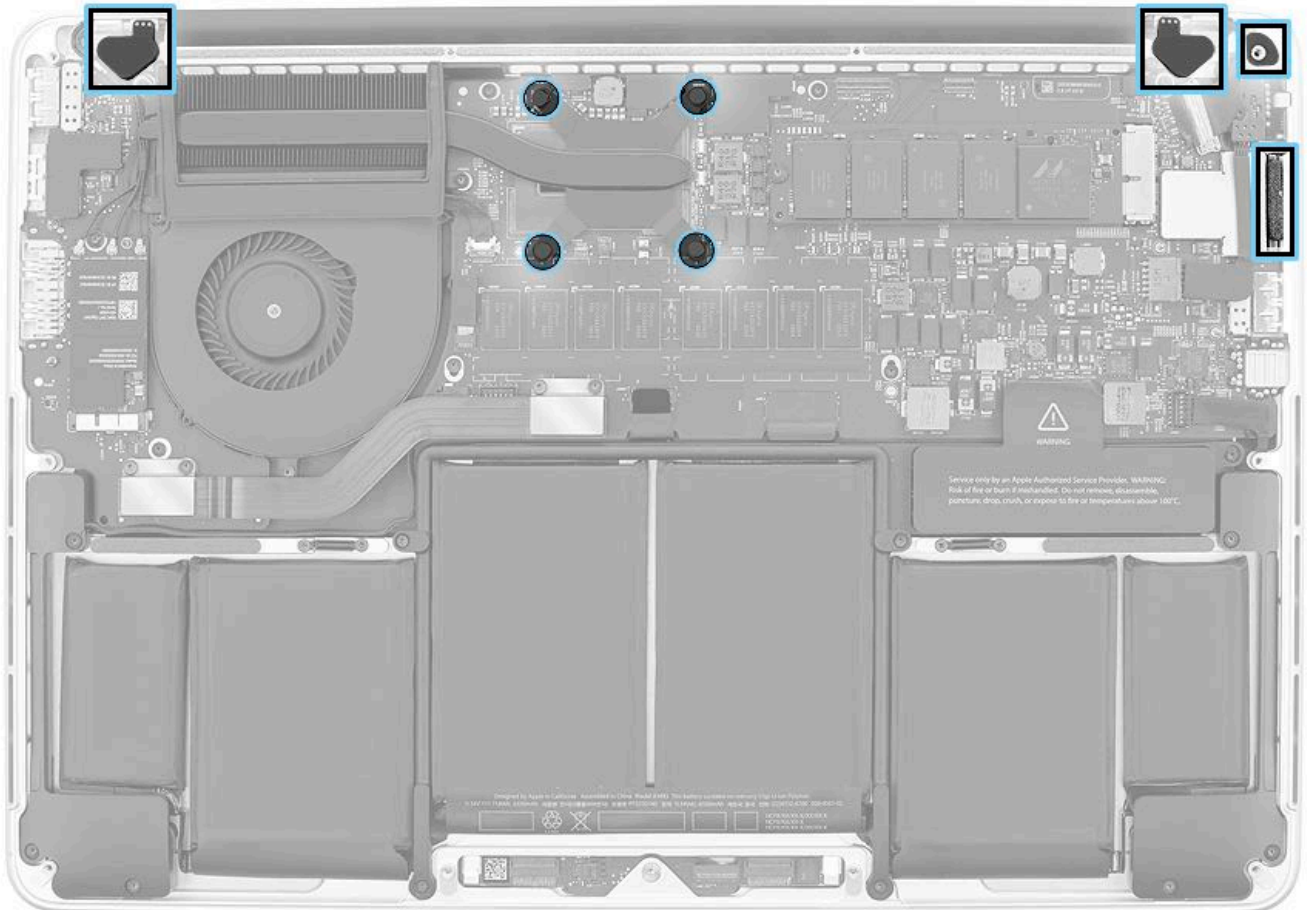


# Internal Views

## MacBook Pro (Retina, 13-inch, Late 2013 and Mid 2014)

Before completing a repair, make sure the following parts are attached:

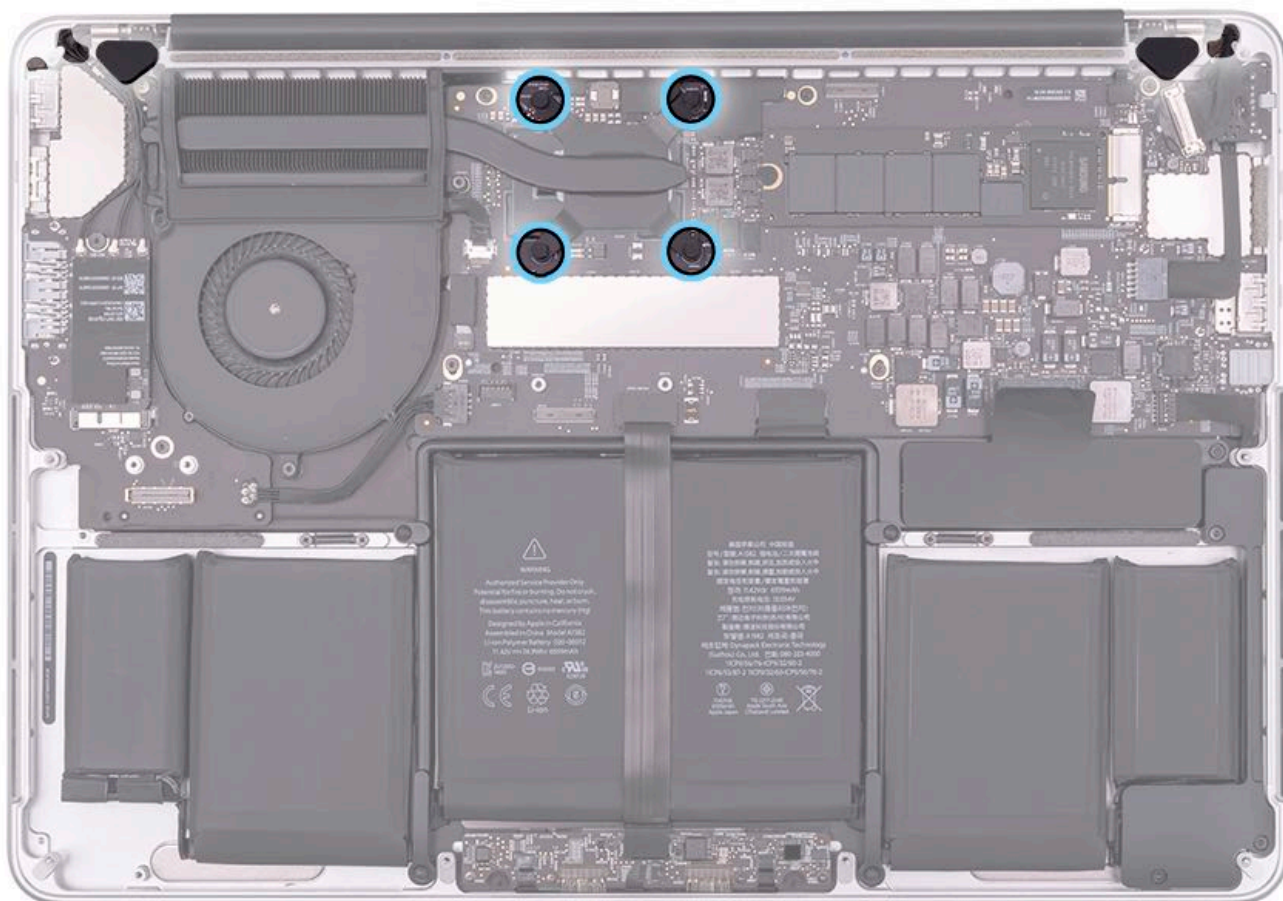
- Rubber screw bumpers on heat sink platform (4)
- Clutch screw covers (2)
- Foam strip at SD port
- Black rubber gasket near video cable



## MacBook Pro (Retina, 13-inch, Early 2015)

Before completing a repair, make sure the following parts are attached:

- Rubber screw bumpers on heat sink platform (4)
- Clutch screw covers (2)
- Foam gaskets in top left and top right corner.



## Service Content Feedback

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